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DIASPIDIDAE OF TAIWAN BASED ON MATERIAL COLLECTED IN CONNECTION WITH THE JAPAN–U.S. CO-OPERATIVE SCIENCE PROGRAMME, 1965

(HOMOPTERA : COCCOIDEA)

PART I

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Introduction

In publishing this paper I wish, first of all, to announce that the present work is based exclusively on material collected by me in Taiwan, where I stayed from the 26th of March to the 19th of April, 1965, as a member of a team which acted under the project of the Japan–U.S. Co-operative Science Programme. The main purpose of this paper is, therefore, to enumerate the Diaspididae found in that collection, but not to give a revision on the whole family of Taiwan. Other material collected in Taiwan available for my study from various sources are all excluded from the present work. During my stay at Tai-pei I had the opportunity to examine some slides from Takahashi's collection, which is deposited in the Taiwan Agricultural Research Institute, but my examination on these slides was not completed owing to that they have lost all trace of stain. The phase-contrast microscopy is useful to such slides, but I have keenly felt that newly prepared material are more useful for detailed examinations. I believe, therefore, that I am not necessarily to blame in entirely neglecting Takahashi's collection in the course of the present work. However, I must confess that I have found some difficulty in identifying certain species described or recorded by Takahashi. I wish for a future opportunity to come back to the Diaspididae of Taiwan and to criticize the present work.

An active study on the Coccoidea of Taiwan was started in 1928 by Takahashi and in 1937 he gave a summary on the coccoid fauna of the island from the viewpoint of the host plants (Taiwan Sôtoku-hu Tyûwô-Kenkyûzyo Nôgyô-bu Ihô 136). His conclusions may largely hold true, but he was erroneous in his view that the fauna of Taiwan is devoid of endemic conifer-feeding species. In reality, the flora of Taiwan has a good number of native conifer species, and the present work has revealed that there occur on them various species of the Diaspididae. The informations from which Takahashi drew his conclusions are apparently incomplete. A considerable number of new species found in the present collection even give an evident proof that our knowledge covers only part of the fauna.

[Insecta Matsumurana, Vol. 32, Pt. 1 (pp. 1–110), July, 1969].

The flora of Taiwan is complicated owing to the climatic and topographic diversity of the island, having various plant communities ranging from the tropical rain forests and the tropical strand forests to the cold-temperate conifer forests and the alpine meadows. From the viewpoint of biogeography the flora of Taiwan is largely composed of the temperate east Asiatic elements, which flourish on the vast mountain area of the island; these elements show an intimate relation of the flora of Taiwan to that of southwestern China, and in a less degree to that of southern Japan. On the other hand, on the lowlands of the island the tropical Asiatic elements grow mostly in the second-growth forests and are interpreted as of comparatively recent invasion. Among the ligneous plants of Taiwan the families Euphorbiaceae, Lauraceae, Rosaceae and Fagaceae are the largest four in the number of the native species. Excepting the Euphorbiaceae and Rosaceae, which are widely distributed over the world, the flora of Taiwan is characterized by having rich species of the Lauraceae and Fagaceae. These plants, forming the so-called Lauro-Fagaceae association, are dominant in the evergreen broad-leaved forests on the mountain-side of the island. The fact that both families are most richly differentiated in southern China may be taken as a proof that the flora of Taiwan, as a whole, has the most close relation with that of southern China (Kanehira, 1936, Formosan trees indigenous to the island, rev. ed. Tokyo; Liu, 1960, Illustrations of native and introduced ligneous plants of Taiwan 1, Tai-pei).

The families Lauraceae and Fagaceae are ones on which the native coccoid species of Taiwan are most numerously found (Takahashi, 1937, l. c.). This suggests that the native coccoid fauna of the island is largely associated with the evergreen broad-leaved forests, and also that it has probably a close relation with the coccoid fauna of southern China. The activities of Ferris brought a lot of material from the coccoid fauna of southern China as the result of his expedition there in 1948 to 1949. A comparison between the faunas of Taiwan and southern China may, then, be possible, but the informations available are still insufficient on both sides and especially on the side of the mainland of China. I will, therefore, not try to make a comparison between the two districts, but it should be noted here that I have been much impressed in the course of the present work with the presence of some closely related forms in both districts. I have also found that some species or genera are particular to both faunas of Taiwan and Japan, but it is quite possible that the Japano-Taiwanese elements will be found to be common also to the fauna of southern China.

On the lowlands of Taiwan the native forests were largely destroyed and have been reshuffled into new flora-fauna communities with many plants and coccoids introduced through the agency of man. The coccoids which are closely related with those occurring in tropical Asia may originally be native to the lowland flora. However, it is not always easy to distinguish the native from the introduced. An evaluation of the tropical Asiatic elements in the coccoid fauna of Taiwan is difficult also owing to that the fauna of tropical Asia has been little studied except in the Indo-Ceylonese, Malayo-Indochinese and Philippine districts, and quite insufficiently in these districts. It should be here added that certain kinds of difficulties encountered in the coccoid taxonomy may have been originated from the destruction of native communities, succeeded by invasions of the introduced. The puzzling group of the *aspidistrae*-complex of *Pinnaspis*, for example, may have been brought about by removing and confounding the locally differentiated forms of the complex for hundreds of years in eastern Asia.

In concluding this introduction I wish to dedicate this paper to the late Dr. Ryôichi Takahashi.

Collecting sites

Yeh-liu. A coastal site near the northern extremity of the island.

Tai-pei city; Pei-tou and Yang-ming Shan, near Tai-pei city. Collecting was made in parks, in gardens, on roadside, on hill-side, etc.

Along the road passing from the Tai-pei through the hilly area of southeastern Tai-pei Hsien to Chiao-shi, northern I-lan Hsien. Native subtropical rain forests largely destroyed and replaced by second-growth forests and plantations.

Chia-i. Collecting in a park and in the campus of the Chia-i Agricultural Experiment Station.

Chu-chi, 120 m. On hills with the native forests completely destroyed and replaced by *Acacia* and several other plants.

Fen-chi-hu, 1,370 m. In the evergreen broad-leaved forest zone.

A-li Shan, 2,270 m. Mixed forests of *Chamaecyparis* and broad-leaved trees. Collecting was made also in a garden with a collection of montane plants including *Abies kawakamii*.

Tung-pu, 2,650 m. A conifer forest of *Tsuga*.

Kuan-tzu-ling, 250 m. Collecting was made mainly in a valley, where native plants grow.

Heng-chun, Ken-ting and O-luan-pi. Native tropical forests largely destroyed. Collecting was made in the Ken-ting Botanical Garden, in private gardens, on roadside, etc.

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I wish also to thank Mr. C. H. Tao, Chia-i Agricultural Experiment Station, for his kindness in giving me the opportunity to collect in the campus of the Experiment

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I am grateful to Dr. D. J. Williams, Commonwealth Institute of Entomology, for his kindness in giving me the opportunity to examine Newstead's material of *Aulacaspis tubercularis* and *Aulacaspis mangiferae.*

I wish to take this opportunity to thank Mr. S. Kawai, Tokyo-to Agricultural Experiment Station, who called my attention to the usefulness of the second instar male in diaspidid taxonomy.

Last but not least, I wish to thank Prof. T. S. Liu, Taiwan University, for his kindness in taking troublesome works for me in identifying many host plants. Without his authorized identification this work would have been never completed.

Major tribes of the Diaspididae

On the basis of morphological and cytological evidences Brown and McKenzie (*1962*)* reclassified armoured and palm scale insects into three families, i.e., the Halimococcidae, Phoenicococcidae and Diaspididae. The palm scale insect family Halimococcidae, newly erected by them, is approximately identical in the generic composition with the subfamily Phoenicococcinae defined by Ferris (*1942*), but does not include *Phoenicococcus* and *Ancepaspis*, which were referred to the subfamily by him. The family Phoenicococcidae as defined by Brown and McKenzie is restricted within a narrow limit, comprising only the two genera *Phoenicococcus* and *Xanthophthalma* With exclusion of all these genera, which are possibly relics of old forms, the family Diaspididae is practically a homogenous group composed of forms primarily with the protective scale covering and the elaborated pygidial architecture. As to the higher taxa within the Diaspididae, Brown and McKenzie adopted the Ferris-Balachowsky scheme, which they modified to accept six tribes: the Aspidiotini and Odonaspidini as defined by Ferris; the Diaspidini and Parlatorini as defined by Balachowsky; and two new tribes, one for *Ancepaspis* and the other for *Comstockiella.*

The family Diaspididae is defined here after Brown and McKenzie, and the groups within the family after Balachowsky (*1948 b*; *1953 g*; *1954 e*). I accept, however, seven tribes instead of Balachowsky's four, elevating his subtribes except of the Aspidiotini to the rank of tribe. One of the reasons for this modification is to faciliate the coming discussion on the relationship of these groups, placing them on an equal, plain footing. Since the tribe Aspidiotini as defined by Balachowsky is a fairly homogenous group, his five subtribes composing it should never be elevated to the higher rank. The second reason, which is more important and essential, is that all these groups here accepted as distinct tribes have their own evolutionary trends as discussed later. Although many genera are still puzzling as to the correct taxonomic position, the bulk of the Diaspididae may belong to the seven groups or tribes given in Table 1.

1) **Tribe Leucaspidini.** This tribe is a small group, comprising pupillarial forms

* The references cited in italics are to be found in Morrison and Renk, A selected bibliography of the Coccoidea, U. S. Dept. Agr. Misc. Pub. 734, 1957 and Morrison and Morrison, First Supplement, 987, 1965.

TABLE 1. Major tribes of the Diaspididae.

Classification in the present work	Classification by Balachowsky (*1948b*; *1953g*; *1954e*)	
Leucaspidini Parlatorini	Parlatorini	Leucaspidina Parlatorina
Rugaspidiotini Odonaspidini	Odonaspidini	Rugaspidiotina Odonaspidina
Aspidiotini	Aspidiotini	Pseudaonidina Selenaspidina Aonidina Targionina Aspidiotina
Lepidosaphedini Diaspidini	Diaspidini	Lepidosaphedina Diaspidina

originated in the Old World. It includes *Leucaspis*, *Lopholeucaspis*, *Salicicola*, *Mongrovaspis* and *Gomezmenoraspis*, all studied precisely by Balachowsky (*1953 g*). Some other genera are also suggested by him as possibly belonging to this group, i.e., *Anamefiorinia*, *Anotaspis*, *Fissuraspis*, *Formosaspis*, *Mixaspis*, *Neoleucaspis*, *Protodiaspis* and *Radionaspis*, but all these genera except the first one should be not referred to this group. *Mixaspis* and *Neoleucaspis* belong to the Parlatorini, and *Formosaspis* and *Protodiaspis* probably to the Diaspidini; *Fissuraspis* is so aberrant that its taxonomic position can not be suggested; also as to the positions of *Anotaspis* and *Radionaspis* any reliable idea has not yet been proposed (Brown and McKenzie, *1962*).

The adult female of this tribe is much reduced or modified in the pygidial fringe and glandular system apparently owing to the pupillarial condition, so the basic characters of the tribe must be looked for in the second instar female. So far as based on the scond instar female of *Lopholeucaspis* or *Leucaspis* this tribe is common with the Parlatorini in some characters: in the pygidial lobes all unilobed, in the broad and apically fimbriate marginal processes or "plates" of the abdomen, in the dorsal macroducts short and broad, with the orifice surrounded by a sclerotized rim, and in the tubercular glanduliferous processes or "gland tubercles" present on the cephalothorax. The combination of all these characters forms a basic pattern within the Diaspididae, which is called in this paper the "parlatorine pattern". The tribe Leucaspidini is characterized, in addition, by the plates of the pygidium all not glanduliferous and by the antennae bearing two or more setae.

In the adult female the parlatorine pattern is not always obvious owing to the reductive modification, while the antennae remain bi- or multisetose and the plates, though modified in shape, are not glanduliferous. The abdominal disc pores are present not only in the usual perivulvar groups but often also in some prepygidial groups. The body-shape is primarily elongate and fusiform.

So far as I am aware it has been not yet attempted to elucidate the second instar male of any species of the tribe, but the illustration of the "second stage female" of *Leucaspis japonica* (=*Lopholeucaspis japonica*) in Kuwana (*1928*, Pl. 8, Fig. G) shows

in reality the second instar male. In the present work the second instar males of two species belonging to *Lopholeucaspis* and *Leucaspis* have been available. In each of these species the second instar male is practically identical with the female of the same instar except for the more numerous macroducts and the presence of the abdominal disc pores. This last character is quite noticeable and I will again refer to it later. It should be here noted only that the abdominal disc pores are found in two groups in the submarginal region on each side of the pygidium, being located on the supposed fifth and sixth abdominal segments.

In the first instar larva the antennae are five-segmented; the head is devoid of enlarged ducts; the plates are well developed around the abdomen; and a pair of sclerotized processes or lobes are distinct towards the posterior extremity of the body just laterally to the apical setae. Another noticeable character is found in the presence of macroducts which are single and occur segmentally along the body margin; on the abdomen each of these macroducts is associated with a plate.

2) **Tribe Parlatorini.** This group is identical with the union of the subtribes Parlatorina and Gymnaspidina defined by Balachowsky (*1958 b*) and is primarily Oriental. It includes *Parlatoria* and its close allies, *Benaparlatoria*, *Genaparlatoria*, *Microparlatoria*, *Parlagena*, *Parlaspis*, *Parlatoreopsis*, and *Syngenaspis*. Some pupillarial genera, which are more or less modified in the adult female, also definitely belong to the tribe, i.e., *Agrophaspis*, *Bigymnaspis*, *Cryptoparlatorea*, *Eugreeniella*, *Greeniella*, *Gymnaspis*, *Mixaspis*, *Neoleucaspis*, *Neoparlatoria*, *Porogymnaspis*, *Sishanaspis*, *Silvestraspis*, etc.

In the non-pupillarial genera the so-called parlatorine pattern as stated in the Leucaspidini is more or less developed in both the adult female and the second instar female, while in the pupillarial genera it is well displayed in the second instar. The definite differences of the Parlatorini from the Leucaspidini lie in that the plates are glanduliferous and the antennae are unisetose in both adult female and the second instar. The abdominal disc pores, which are usually present in the adult female, are confined within the perivulvar groups. The body-shape is generally oval to round although quite elongate in certain pupillarial forms.

A detailed comparison between the second instar male and female of *Parlatoria blanchardi* made by Stickney (*1934 a*) shows that the sexual difference in this instar is slight and that the male differs from the female mainly in the glandular system somewhat more developed; the pygidial fringe is similar among all of the adult female and the second instar male and female. The same type of sexual dimorphism is found in four other species of *Parlatoria* examined by myself in connection with the present work: in all the species the males differ from the females by the more numerous dorsal macroducts and by the constant presence of gland tubercles which are absent in the females of two species. In any other genera of the tribe sexual dimorphism in the second instar has not been discussed, but the "II stadio larvale della femmina" of *Silvestraspis sinensis* (=*S. uberifera*) and the "II stadio femminile" of *Porogymnaspis silvestrii* described and illustrated by Bellio (*1929*; *1929 a*) may very possibly be the second intar males in reality; it is assumed from his descriptions and illustration that in these genera sexual dimorphism in the second instar is of the same type as that of *Parlatoria*.

The first instar of *Parlatoria blanchardi* was precisely studied by Stickney (*1934 a*).

Throughout this tribe the first instar larva has five-segmented antennae and lacks enlarged ducts on the head. The marginal structure of the body is variable, but the following characters seen in *Parlatoria* may be taken as the basic properties of the tribe: the sclerotized processes or lobes are easily recognized in two pairs towards the posterior extremity of the abdomen and all unilobed; membraneous marginal processes or plates occur only on some posterior segments of the abdomen, tending to be reduced in size and modified in shape into more or less tubercular processes; and the ducts occurring along the body margin are all reduced into slender microducts. A considerably deviated form is found in *Neoparlatoria*, in which the posteriormost lobes alone are well developed and set close together and the plates are all transformed into remarkable glanduliferous spiniform processes.

3) **Tribe Rugaspidiotini.** Balachowsky (*1953 g*) referred the following genera to his subtribe Rugaspidiotina: *Rugaspidiotus*, *Rugaspidiotinus* and *Annulaspis* from the New World and *Discodiaspis*, *Nimbaspis* and *Osiraspis* from the Old World. So far as represented by the type-species the genus *Rugaspidiotus* is a puzzling form and it is open to doubt that this genus really belongs to the same group with the others (Ferris, *1938 a*). *Comstockiella* and *Leonardiana* also have some resemblance to the genera of this group, but their exact affinities are unknown. In the present work *Poliaspoides*, which was included by Balachowsky (*1953 g*) within *Rugaspidiotus*, is accepted as valid, and *Smilacicola* (n. g.) is proposed.

From the taxonomic, but not nomenclatorial, viewpoint the nucleus of this tribe may be laid on the genus *Rugaspidiotinus*, *Poliaspoides* or *Smilacicola*. Through all these genera the pygidium of the adult female shows no trace of any marginal processes such as lobes, or plates or gland spines, and is strewn with many short ducts on both surfaces. The ducts are also scattered rather than segmentally arranged on the prepygidial segments. The antennae bear two or more setae. The second instar female is generally a rough duplicate of the adult female, but in certain species it has more or less developed marginal processes on the pygidium. The body-shape is generally more or less elongate.

No published information is found concerning the second instar male of any species referable to this tribe. In the course of the present work the second instar male of *Smilacicola* has been examined. It is evidently of the parlatorine pattern, exactly agreeing with the adult female and second instar of *Parlatoria* in the distinct pygidial lobes, well-developed glanduliferous plates, thickly rim-orificed macroducts, cephalothoracic gland tubercles, etc. The phylogenetic significance of this noticeable fact will be discussed later. It should be added here that in the second instar male of *Smilacicola* the antennae are multisetose as in the adult and second instar females and the distribution of the dorsal macroducts holds a marked segmentation.

In the first instar larva the antennae are five-segmented in some species, whereas six-segmented in others, and in certain species the head is provided with a pair of enlarged ducts (Ferris, *1936 a*; *1937 d*; *1938 a*; *1938 b*; Balachowsky, *1953 g*). In the first instar larva of *Smilacicola*, which is under my own examination, the antennae are six-segmented, the head is devoid of enlarged ducts, the lobes are sclerotized only in one pair, the plates are comparatively well developed on the abdomen, and the marginal ducts around the body are all reduced into microducts.

4) **Tribe Odonaspidini.** This is a small group of graminivorous species, comprising

Odonaspis mainly from southeastern Asia and North America and *Circulaspis* from North America.

This tribe is close to the Rugaspidiotini, the adult female being characterized by lacking marginal processes on the pygidium except for the fused median lobes, which are present in most species and more or less merged into the pygidial margin, and by having numerous ducts scattered on both surfaces of the pygidium and on the lateral areas of the body. The ducts are, however, all small in size; the antennae unisetose; the "paratergal" areas of the body more or less sharply delimited; and the intersegmental lines sclerotized in comb-like series of spicules. In many species the pygidium is provided with slender marginal intersegmental scleroses, and in certain species the prosoma with gland tubercles. All these characters distinguish this tribe from the Rugaspidiotini. The body-shape is broadly oval.

I have examined the second instar males of some species of *Odonaspis* from various sources. They are quite different from the adult females by having separated median lobes, glanduliferous plates, large rim-orificed ducts and gland tubercles. Although the plates are reduced in size and restricted towards the apex of the pygidium, the male characters of the second instar are undoubtedly of the parlatorine pattern. The second instar female is in general similar to the adult female, but in a certain species (*Odonaspis secreta*) the pygidial processes are comparatively well developed, holding to the parlatorine pattern.

The first instar larva, so far as known in *Odonaspis* and *Circulaspis*, has five-segmented antennae, of which the third segment is unusually longer than the neighbouring, and is devoid of enlarged ducts on the head (Ferris, *1938 a*). In some species of *Odonaspis* under my examination the lobes are sclerotized only in one pair, the plates are comparatively well developed towards the posterior extremity of the body, and the marginal ducts around the body are reduced into microducts.

5) **Tribe Aspidiotini.** This tribe is here accepted in conformity with the definitions given by Ferris (*1942*) and Balachowsky (*1948 b*). It is a large group, comprising a long list of genera and occurring widely in the world, but is considerably homogenous. This tribe definitely includes some pupillarial genera, which are, however, comparatively very few in number. It may be tedious and not necessary to give here a list of some genera belonging to this tribe.

The principal or common structure of the pygidial margin of the adult female is evidently of the parlatorine pattern, by having unilobed pygidial lobes and well-developed glanduliferous plates. The plates are, however, crowded towards the apex of the pygidium, and the prepygidial region of the body is devoid of plates and gland tubercles. There is also a pronounced tendency in the prepygidial region towards the reduction of other glandular organs such as ducts and spiracular disc pores, the latter being usually lacking. The ducts are basically much elongate and slender, sometimes filiform, with the inner end "one-barred", but this type of duct is not always constant throughout the tribe. The antennae are mostly unisetose. The body-shape is generally broadly pyriform to round.

Certain genera referred by Balachowsky (*1958 b*) to his subtribe Furchaspidina deviate from the main part of the tribe by having multisetose antennae, gland tubercles and prepygidial abdominal disc pores.

The second instar larvae of both sexes were examined in some species of the tribe

by authors and in detail by Boratyński (*1952 b*). In connection with the present work the second instar males of some aspidiotines belonging to *Aspidiotus* and other genera have been examined. All the informations at hand show that the type of sexual dimorphism in the second instar in the Aspidiotini is similar to that found in the Parlatorini, the difference between the male and female being slight and almost restricted to the ducts.

Based on the extensive studies made by Ferris it is concluded that throughout the authentic genera of the tribe the first instar larva has five-segmented antennae and is devoid of enlarged ducts on the head. So far as my limited examination goes, the sclerotized lobes are present in one or two pairs; the plates are more or less developed towards the posterior end of the body; and the marginal ducts around the body are all reduced into microducts.

6) **Tribe Lepidosaphedini.** This group is composed of many genera from various parts of the world. In Far East occur *Lepidosaphes* and some other genera, i.e., *Acanthomytilus*, *Andaspis*, *Cynodontaspis*, *Neopinnaspis*, *Pallulaspis*, etc., all these being undoubtedly referable to the tribe. Other genera which are close to *Lepidosaphes* are: *Aonidomytilus*, *Coccomytilus*, *Fulaspis*, *Lapazia*, *Nilotaspis*, *Opuntiaspis*, *Triraphaspis*, *Ungulaspis*, *Velataspis*, etc. There are known also many genera which are not typical lepidosaphedine forms but have some resemblance to the latter, and perhaps some of them, if not all, may actually fall in the Lepidosaphedini. Balachowsky (*1954 e*) studied precisely some of such forms ("espèces à mégapores absents").

The authentic forms of the tribe are quite distinct from all the preceding tribes by the pygidial lobes bilobulate except the mesalmost pair, by having elongate spiniform glanduliferous processes or "gland spines" which occur as anteriorly as the thoracic region, and by having differentiated marginal macroducts on the pygidium, which are associated with marginal prominences. The gland spines occurring on the thorax and the base of the abdomen are usually much shortened and will be called "gland cones" in the present paper, although they may at times be hardly distinguishable in appearance from the gland tubercles of the preceding tribes. All these characters, which should make the "lepidosaphedine pattern", are also commonly exhibited by the following tribe of Diaspidini. The authentic forms of the Lepidosaphedini are distinguished from the Diaspidini basically by having a pair of gland spines between the median lobes and by the marginal macroducts of the pygidium particularly enlarged ("mégapores" of Balachowsky). The antennal setae are variable in number, but usually two or more. The body-shape is elongate and more or less fusiform.

The second instar male and female of *Lepidosaphes ulmi* were compared in detail by Boratyński (*1952 b*). In the present work the second instar males of a few other species belonging to *Lepidosaphes* and *Andaspis* have been examined and compared with the females of the same instar. In all these species the type of sexual dimorphism in the second instar is similar to that found in the Parlatorini and Aspidiotini, the male differing from the female mainly by the glandular system more developed and both male and female of this instar are practically identical with the adult female in the pygidial margin.

In most of the authentic genera of the tribe the first instar larva has six-segmented antennae and is provided with a pair of enlarged ducts on the head, but Ferris' extensive studies on diaspidid genera show that certain other genera which are definitely or

probably referable to the tribe have five-segmented antennae. So far as examined by myself *Lepidosaphes*, *Acanthomytilus* and *Andaspis* agree well in the fundamental structure of the first instar larva. A noticeable character in these genera is the presence of gland spines on the abdomen, which are single and occur segmentally. It is also noticeable that any segment which is provided with a gland spine is devoid of a marginal duct. The posteriormost pair of gland spines are found between the lobes, which are quite distinct. Just laterally to each lobe there is a smaller process, which, tending to be sclerotized, may be taken as the outer lobule of the lobe. A similar process is found anteriorly, on the supposed preceding segment. Between the posteriormost pair of gland spines are found another pair of processes, which are similar in appearance to the plates of the Diaspididae parlatoriformes.

7) **Tribe Diaspidini.** This group finds parallel with the Aspidiotini in the number of genera included, occurring all over the world. In the composition here accepted, which is identical with that of the Diaspidina defined by Balachowsky (*1954 e*), this group appears to be quite heterogenous, having a wide range of forms.

One extremity of the tribe is represented by *Diaspis* and some allied genera such as *Carulaspis*, *Furchaspis*, *Epidiaspis*, *Malleolaspis*, *Neosignoretia*, *Paraepidiaspis*, *Situlaspis*, etc. In these genera the median lobes of the pygidium of the adult female are set distinctly apart from each other, usually with a marginal macroduct and sometimes a pair of gland spines between them. Other genera such as *Balaspis*, *Lineaspis*, *Pseudoparlatoria*, *Pudaspis*, *Vinculaspis*, etc. are also referable to this section, having a pair of gland spines between the median lobes. At the other extremity of the tribe stand the genera in which the median lobes of the pygidium are zygotic, that is, fused basally or throughout, without any marginal processes between them. Some of the genera fall in this section are: *Africaspis*, *Aulacaspis*, *Chionaspis*, *Contigaspis*, *Fiorinia*, *Greenaspis*, *Moraspis*, *Pinnaspis*, *Pseudaulacaspis*, *Rolaspis*, *Tecaspis*, etc. These extremities are united through various intermediate forms such as *Augulaspis*, *Dentachionaspis*, *Dentaspis*, *Duplachionaspis*, *Duplaspis*, *Nelaspis*, *Unaspis*, *Voraspis*, etc. Besides varying in the pygidial margin, the adult females are also not uniform in other characters. The antennal setae are quite variable in number, but there is some tendency that the multisetose antennae are associated with the non-zygotic median lobes. The body-shape is variable from an enormously elongate slender type to a broadly oval, pyriform or turbinate type.

All the genera mentioned above appear at a glance quite variable, but make a successive series concerning the pygidial margin; it seems, therefore, that they belong to a large common phylogenetic stock. However, there are also many other genera which are more or less deviate from this series and yet have some resemblance to it. It is not possible within the available informations to delimit this tribe exactly. A sharp distinction between the Diaspidini and Lepidosaphedini is also difficult so far as based on the microscopic characters of the adult females. Nevertheless, the informations at hand on the second instar of the Diaspidini reveal a peculiar type of sexual dimorphism, which may give support to the view that the tribe Diaspidini is a distinct group. Some genera which definitely belong to this tribe are pupillarial.

The published studies on the sexual difference in the second instar or on the second instar males are found in Geier (*1949*), Boratyński (*1952 b*) and Takagi and Kawai (1967, Ins. Matsum. 30: 29–43) and include some species belonging to *Epidiaspis*, *Carulas-*

pis, *Chionaspis*, *Aulacaspis* and *Pseudaulacaspis*. There have been also available for my examination, from various sources, the second instar males of many other species belonging to *Diaspis*, *Unaspis*, *Kuwanaspis*, *Unachionaspis*, *Fiorinia*, *Pseudaulacaspis*, *Greenaspis*, *Chionaspis*, *Aulacaspis*, *Pinnaspis*, etc. In these genera the sexual difference in the second instar is generally greater than in the Lepidosaphedini, the male differing from the female not only in the glandular systems, but also in the marginal processes of the pygidium. The glandular system is, as usual in other tribes, more developed in the male so far as the number of ducts is concerned, often with peculiar ducts in the male. The common feature of the marginal processes of the pygidium of the male is their reduction, which is, however, variable in detail in the examined species. For example, in certain species (*Carulaspis*; *Unaspis*) the lobes and gland spines are only slightly modified and still identified; in some species (*Chionaspis*) all the marginal processes of the pygidium are modified into more or less plate-like prominences; and in some others (*Aulacaspis*; *Pinnaspis*), which stand at the end of the reductive modification, the marginal processes are quite rudimentary. It is a noteworthy fact that in the second instar male there occurs no distinct reduction of the ninth abdominal segment so far as indicated by the marginal processes even in the species which have the zygotic median lobes in the adult and second instar females. The second instar female is practically identical with the adult female in the pygidial margin except in pupillarial forms.

The first instar larva has five- or six-segmented antennae. There seems to be some tendency that the six-segmented antennae of the first instar are associated with the non-zygotic median lobes of the adult female and the five-segmented antennae with the zygotic median lobes, but both types of the antennae may occur even in the same genera. The head is usually provided with a pair of enlarged ducts, and the presence and absence of these ducts may occur in the same genera. In many genera the marginal structure of the abdomen is similar to that of the authentic genera of the Lepidosaphedini, but differs from the latter by lacking a pair of gland spines just mesally to the lobes. In some genera the marginal processes are reduced or practically obsolete except for a pair of posteriormost small spiniform processes. In certain genera (*Greenaspis*; *Thysanofiorinia*) the body is equipped around with enlarged, spine-like marginal setae.

Evolutionary patterns within the Diaspididae

Whatever kind of the Coccoidea gave origin to the family Diaspididae, which is generally accepted as the ultimate product of coccoid evolution, the characters possessed by the family must be partially in inheritance from the ancestral form and partially in new acquisition. The further modification of the inherited characters and the further development of the acquired, within the family, are two main aspects in the evolutionary trends of the family.

One of the inherited characters is undoubtedly the disc pore, which is the commonest property of all the Coccoidea. The absence of the disc pore is, therefore, the result of loss. The abdominal disc pores of the Diaspididae are of the quinquelocular type, which is common also in the lecanoid families. They are called "perivulvar pores" by authors, since they are usually confined within the perivulvar region of the pygidium of the adult female. However, they are found also on one or more prepygidial segments

in various species of the Leucaspidini, Aspidiotini, Lepidosaphedini and Diaspidini. Moreover, it has been detected in the course of the present work that in certain leucaspidines the abdominal disc pores are present in the second instar males too, in the submarginal region of the pygidium. A probable interpretation of these facts is that the abdominal disc pores were originally of the universal presence in the larvae of both sexes and the adult female and have been gradually reduced during the evolutionary sequence within the family.

The spiracular disc pores are also of the lecanoid origin, and their reduction is a general trend in the family. The presence or absence of spiracular disc pores was used by Brown and McKenzie (*1962*) in their discussion on the evolutionary patterns within the family. The spiracular disc pores of the Diaspididae belong to two types—trilocular and quinquelocular. It is not within the limited informations at hand to presume what meaning the presence of the two types conveys. It should be only noted that the trilocular type is scattered in the family. In a certain genus (*Collubia*) the spiracular disc pores of the adult female appear to be quadrilocular.

Another important dermal organ of the Diaspididae is the tubular duct. The two dominant types called by Ferris (*1942*) "one-barred" and "two-barred" ducts are peculiar to the family. A third type, which is found in the Halimococcidae and Phoenicococcidae and perhaps restricted to the larval instars in the Diaspididae, presents an 8-shaped figure in cross section. Since its figure in cross section is similar to the geminate pore of the Asterolecaniidae, the 8-shaped duct is looked upon as a transitional type between the one- and two-barred ducts of the Diaspididae and the geminate pore of the Asterolecaniidae (Stickney, *1934*). If the duct of the Diaspididae really originated from the geminate pore, the first step of this change may have been taken in a short invagination of the geminate pore into the interior of the body, whereas the enormously elongate duct of the Aspidiotini, which is of the one-barred type, is possibly the ultimate product. This assumption is supported by the presence of the invaginated geminate pore in certain asterolecaniids and coccids. On the other hand, there is no positive evidence that the tubular duct of the lecanoid families was inherited by the Diaspididae.

The distribution of the 8-shaped duct is not known enough throughout the Diaspididae to allow a definite conclusion to be drawn on the taxonomic significance of its presence. It is well known that in many species a pair of enlarged ducts occurring on the head of the first instar larva belong to this type. In some species ducts occurring elsewhere in the first instar and also in the second instar fall in this type.

The antennae are originally multisegmented in the Coccoidea, and this holds true for the first instar and the adult male of the Diaspididae. In the second instar and the adult female the antennae are simple unsegmented tubercles, or sclerotized points, with one or more setae, and this state is evidently the result of reduction in accordance with the sedentary habit in these instars. I agree with Brown and McKenzie (*1962*) in their view that the number of setae may have gone on decreasing in further reduction of the antennae, which are finally mere unisetose points.

In the first instar the antennae are five- or six-segmented. It is hardly acceptable that the antennae of the first instar have suffered from any remarkable reductive modification, since in the Diaspididae this instar is the only stage in which an effective dispersal takes place. However, the most direct explanation for the presence of the two types of the antennae may be that the five-segmented type originated from the

six-segmented through a reductive change. In so far as the reverse change is not accepted this reduction may have happened many times, since both types occur sometimes within the same tribes or genera.

The marginal processes of the abdomen, which are the lobe, plate and gland spine, are all particular to the family. The adult female of the Rugaspidiotini and Odonaspidini are devoid of whole or most processes on the abdomen, but the second instar males of certain species belonging to these tribes are provided with both lobes and plates, necessarily proving that these processes have been lost in the adult female. It is also quite within the bounds of possibility that the other aberrant forms of the adult female which have no trace of the marginal processes may be the results of loss of these processes and that, since such forms are scattered in the family, the loss of the marginal processes may have happened independently in these forms. In some of them the second instar female actually has lobes and other marginal processes.

The marginal processes of the abdomen are evidently new characters acquired by the ancestor probably of all the existing forms of the Diaspididae. There is known no form in the Diaspididae which positively proves the origin of the marginal processes, but comparisons of various types of the first instar within the family give some clue to the differentiation of the three kinds of marginal processes. An assumed sequence

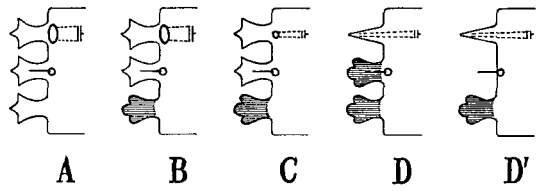


Fig. 1. Diagrams of some types of the marginal processes in the first instar (for explanation see text).

here adopted of the differentiation of these processes in the first instar is shown in Fig. 1. A primary abdominal segment is supposed to have three plates on each lateral margin and one of them, say the anteriormost plate to be associated at its base with a macroduct (Fig. 1, A); it is assumed that *Thysanaspis* has remained in this stage. The first step of differentiation is made in that the posteriormost plate is modified into a sclerotized lobe (B); this step is represented by *Lopholeucaspis* and *Leucaspis*. In the next step the macroduct associated with the anteriormost plate is reduced into a microduct (C); this step is seen in *Parlatoria*, *Smilacicola*, *Odonaspis*, *Aspidiotus*, etc. The ultimate step in this succession is accomplished by the Lepidosaphedini and Diaspidini, in which the anteriormost plate is modified into a glanduliferous spiniform process or gland spine, with the associated microduct running through it and opened at the apex of it, and the remaining two plates are sclerotized into lobes (D). The change from the type C to D is great and there is known no intermediate type proving this change. The change of the plate into a glanduliferous spine, however, happened also within the Parlatorini: the spiniform marginal processes of *Neoparlatoria* (D') must necessarily be homologous with the plates of *Parlatoria* or other generalized parlatorines.

The undifferentiated plate is, therefore, supposed to be non-glanduliferous, and this is perhaps the stage in which both the larval instars of *Thysanaspis* are found. The

differentiated plate is also supposed to be primarily non-glanduliferous as in the types B and C of the first instar; the second instar and the adult female of the Leucaspidini may have remained in this stage, their pygidial plates being all non-glanduliferous.

In the great majority of the Diaspididae the body of the adult female still retains a more or less pronounced segmentation. This constitution of body can not be drawn from many existing forms of lecanoids, in which the adult female has much advanced to lose segmentation not only in the dermal structure but also in the distribution of the pores and ducts. The family Diaspididae must, then, be a descent from a generalized lecanoid, of which the body is distinctly segmented. An outstanding evolutionary trend within the Diaspididae is "heteromerization" or the differentiation of the body into distinct parts. The separation of the body into the pygidial and prepygidial regions is the basic and common feature of the family, and in general the marginal processes and the glandular system are well developed in the pygidial region, whereas in the prepygidial region the marginal processes are more or less dedifferentiated or even wholly obsolete and the glandular system is less developed. A less pronounced heteromerization is seen in the separation of the body into the prosoma, or the united head, prothorax and mesothorax, and the postsoma, or the metathorax and abdomen. Any heteromerization may have advanced with the evolutionary sequence within the family. The segments composing the pygidium are strongly arched posteriorly, and this arching may have also advanced during the evolutionary sequence. The median lobes of the pygidium are generally regarded as belonging to the eighth abdominal segment, and the marginal area between them, which belongs probably to the ninth abdominal segment, is more or less reduced owing to the arching of the eighth segment. It can be assumed, therefore, that the varying state of the ninth segment corresponds with the evolutionary sequence within the family. The body-shape of the adult female is quite variable in the family. The enormously elongate type and the rounded type may be associated with the sedentary habit. The moderately elongate elliptical or fusiform type may be taken for the primary body-shape of the family.

In part of the Diaspididae the sexual difference in the second instar is quite great, the male not bearing the slightest resemblance to the female. Since in the other families of the Coccoidea the larval instars are in general similar between the male and female, such remarkable sexual dimorphism may be an acquired character in the evolutionary sequence within the Diaspididae.

In the tribes Leucaspidini, Parlatorini, Aspidiotini and Lepidosaphedini the sexual difference in the second instar is, so far as known, not great. In the pygidial fringe the larvae of both sexes are practically identical and are very similar to the adult female except in the pupillarial forms. The main and practically only difference between the male and female of the second instar is found in the glandular system, which is always comparatively more developed in the male. However, there is no fundamental difference between the male and female in the glandular system, the difference there mainly concerning the number of ducts and that generally not in a ramarkable degree. As a whole, the male and female of the second instar in these tribes are practically "homomorphic". By having more numerous ducts the second instar male generally resembles the adult female more than does the second instar female. As rightly pointed out by Boratyński (*1962 b*), the sexual difference in the glandular system is evidently correlated with the formation of the scale covering: the whole male scale is produced

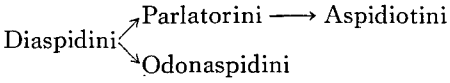
exclusively in the larval instars, whereas the female scale is completed in the adult instar, the production by the second instar female occupying a small portion of the completed scale. This fact leads to the assumption that the similarity of the second instar male to the adult female in the development of the glandular system may be merely analogous, being resulted from a similar functional necessity. Adopting this assumption, I can not agree with Boratyński in his opinion that in the ontogenetic development the second instar male is more advanced than the second instar female and so occupies a position intermediate between the second instar female and the adult female. In other words, the comparatively poor condition of the glandular system in the second instar female may be the result of a reductive change.

In the tribes Rugaspidiotini and Odonaspidini the second instar male is quite different from the adult female, and its characters are unmistakably of the parlatorine pattern. In a certain genus (*Smilacicola*) the second instar male is even quite identical with the second instar and adult female of *Parlatoria* in every respect except in the multisetose antennae and, in comparison with the adult female of *Parlatoria*, in the absence of perivulvar pores and the segmental distribution of dorsal macroducts. It is hardly probable that such an exact agreement of characters comes into existence through a mere coincidence. The only reasonable interpretation may be that these tribes are originally closely related to the Parlatorini or any other group of which the characters are of the parlatorine pattern, and the second instar male remains in its primary state. In that case the adult female is much differentiated from the original parlatorine form, leaving no trace of the characters of the latter except for the occasional presence of gland tubercles. The second instar female is generally more or less similar to the adult female, so being more advanced than the second instar male in the ontogenetic sequence. Since the glandular system is quite different between the second instar male and female in the size, type and distribution of ducts, a comparison in the number of ducts may be not adequate for measuring the development of the glandular system. Yet, the glandular system of the second instar male is apparently well developed with many broad macroducts, whereas that of the second instar female is composed of slender ducts.

In the tribe Diaspidini the second instar male and female are also "heteromorphic", but the type of heteromorphism in this tribe is different from that in the Rugaspidiotini and Odonaspidini owing to the lesser or greater reduction of the marginal processes and the presence of peculiar ducts, both on the side of the male. The reductive modification of the marginal processes in the second instar male is so far as known, restricted largely within the Diaspidini and, as pointed out by Boratyński (*1952 b*), is related with the manner of formation of the scale. In this tribe the male scale is quite different from the female scale in texture and rather similar to the felted sac covering of some lecanoids of the Pseudococcidae, Eriococcidae, etc.; the formation of the male scale may be also modelled after that of the lecanoid sac cover, in which any marginal processes would be found of no use. The ducts in the second instar male is far more numerous than in the second instar female and are scattered practically all over the body. This difference between the male and female is so great that it can not be sufficiently explained only by the difference in the time of the scale formation in the life cycle. The numerous, scattered ducts of the male must probably be associated with the manner of formation and the texture of the male scale. The modified ducts, which are peculiar to the second instar male of the tribe, may be also associated with the textural

character of the scale. The fact that the reduction of the ninth abdominal segment does not take place in the second instar male of the Diaspidini may suggest that also in this tribe the second instar male tends to remain in its primary state, which is, however, more or less affected by the reductive modification.

All the characters discussed above would give a basis for reasoning on the phylogenetic relationship among the major tribes of the Diaspididae. Brown and McKenzie (*1962*) arranged their three major tribes in a series, Diaspidini-Parlatorini-Aspidiotini, on the basis of pygidial characteristics, supposing the Diaspidini to be less adapted to the armoured-scale mode of life than the other two tribes owing to the pygidial fringe comparatively less developed and putting the Parlatorini between the Diaspidini and Aspidiotini. The tribe Odonaspidini was supposed by them to be a second derivative from the Diaspidini. The phylogenetic relationship of their four tribes is, therefore:



The available informations on the ontogenetic development show that the Parlatorini, Aspidiotini and Odonaspidini, as defined by Brown and McKenzie, are closely related, whereas there is in these informations no positive evidence that these tribes are descents from the Diaspidini. Moreover, I can not agree with Brown and McKenzie in their opinion that the Diaspidini is less adapted to the armoured-scale mode of life, unless there is any evidence that the tribe is actually inferior in the formation of scale. In fact, there seem to be three main types in adapting to such mode of life: one of them is the type with the plate, another with the gland spine, and the rest without any prominent marginal process. The last type is probably the result of loss, being a derivative from either the first or second. Accordingly, there may be recognized two original types: the plate type and the gland spine type.

Of my seven tribes of the Diaspididae, the Leucaspidini, Parlatorini, Rugaspidiotini, Odonaspidini and Aspidiotini belong to the plate type, and the Lepidosaphedini and Diaspidini to the gland spine type. I will tentatively call the former five tribes "Diaspididae parlatoriformes" and the latter two "Diaspididae lepidosaphediformes". In the Diaspididae parlatoriformes the marginal processes are primarily plates and unilobed lobes, whereas in the Diaspididae lepidosaphediformes gland spines and bilobulate lobes, typically with secondary prominences bearing differentiated marginal macroducts.

The Leucaspidini and Parlatorini are included within the same tribe in the Balachowsky scheme. The two are, indeed, common in some important characters, but the difference between the two in the plates, abdominal disc pores, antennae, etc. are nevertheless great in the evolutionary meaning. The tribe Parlatorini is evidently more advanced than the Leucaspidini. As for the Rugaspidiotini and Odonaspidini it may be not necessary to repeat here their parlatorine pattern in the second instar male and their probable relation with the Parlatorini. The parlatorine pattern in the second instar male, however, is somewhat different between these tribes. In the Rugaspidiotini the main characters of the second instar male agree exactly with the basic or generalized pattern of the Parlatorini, whereas in the Odonaspidini the second instar male intimates a particularized form of the Parlatorini. Moreover, the tribe Rugaspidiotini is retarded by having multisetose antennae in the second instar and the adult female. On the other

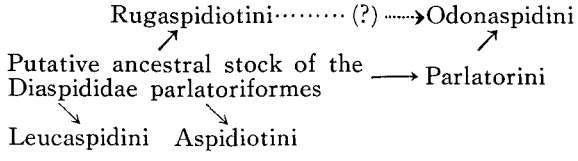
hand, in the pygidial margin of the adult female this tribe is more advanced than the Odonaspidini, since in the former the marginal processes are completely extincted, whereas in the latter the fused median lobes still remain in most species. These facts throw shades somewhat different between the two tribes. Although the tribe Rugaspidiotini is very close to the basic stock of the Parlatorini, it can not be a descent from the latter owing to the multisetose antennae in the second instar and the adult female. In that case the departure of the Rugaspidiotini must be traced back to the more primitive stock preceding the existing Parlatorini. The tribe Odonaspidini may be a successive derivative from the Rugaspidiotini, but it is also possible that the tribe is an independent offshoot from a particularized stock of the Parlatorini.

The tribes Parlatorini, Rugaspidiotini, Odonaspidini and Aspidiotini agree in the fundamental structure of the abdominal margin in the first instar, proving their very probable descents from a common phylogenetic stock. Although the tribe Aspidiotini is highly particularized in the adult female owing to the advanced heteromerization of body and the much elongate ducts its pattern of the pygidial fringe is basically identical with that of the Parlatorini. The presence of gland tubercles in the Furchaspidina offers another evidence of the parlatorine affinity of the Aspidiotini. This subtribe retains other primitive characters such as the multisetose antennae and the prepygidial abdominal disc pores. On account of these characters the departure of the Aspidiotini must be traced among the existing Diaspididae parlatoriformes back to the Leucaspidini.

The tribe Leucaspidini is evidently the most primitive among the major groups of the Diaspididae parlatoriformes. It is hardly probable, however, that the other tribes of the Diaspididae parlatoriformes are direct or indirect descents from the Leucaspidini, since so far as represented by the existing forms the Leucaspidini are all pupillarial. The pupillarial forms of the Diaspididae are generally accepted as offshoots from related non-pupillarial forms, and if the reverse change is not accepted the ancestral forms of the Parlatorini, Rugaspidiotini, Odonaspidini and Aspidiotini, which all probably are primarily non-pupillarial, must be necessarily non-pupillarial.

In the first instar of most Diaspididae parlatoriformes the antennae are five-segmented and the head is devoid of enlarged ducts. In part of the Rugaspidiotini, however, the antennae are six-segmented and the head is provided with a pair of enlarged ducts. This may suggest that the primary type of the first instar of the Diaspididae parlatoriformes had six-segmented antennae and enlarged cephalic ducts.

The ancestral stock of the Diaspididae parlatoriformes is supposed to be non-pupillarial, with well-developed marginal processes on the whole abdominal segments, well-developed gland tubercles, multisetose antennae, segmentally arranged macroducts, abundant abdominal disc pores and other primitive characters in the second instar and the adult female. The Leucaspidini is perhaps the earliest offshoot from the ancestral stock, and the Rugaspidiotini, Aspidiotini and Parlatorini are presumably later offshoots. The phylogenetic relationship of the major groups of the Diaspididae parlatoriformes may be given as follows:



The Lepidosaphedini and Diaspidini are very similar in their generalized forms, from which the evolutionary sequences within these tribes take the departure towards directions different between them. In the Lepidosaphedini the evolutionary changes are mainly concerned in the reduction or modification of the antennae, abdominal disc pores, gland spines, marginal and dorsal ducts, etc., whereas in the Diaspidini, in addition to such changes, distinguished trends take place towards the reduction of the ninth abdominal segment in the adult and second instar females and the reduction of the marginal processes in the second instar male. Both these trends are interrelated at least in some degree, and this shows that the adaptation to the felted sac-like male scale may have advanced with the evolutionary sequence within the Diaspidini. As a whole the tribe Diaspidini is more advanced or particularized than the Lepidosaphedini. Adopting the assumption already given in this paper on the differentiation of the marginal processes (p. 13), the group of the Diaspididae lepidosaphediformes must be a descent from the Diaspididae parlatoriformes. In the Diaspididae lepidosaphediformes many species still retain a pronounced segmentation of the body, bi- or multisetose antennae, prepygidial glanduliferous processes, and spiracular disc pores associated with either pair of the spiracles; some species even retain prepygidial abdominal disc pores. In the first instar larvae the six-segmented antennae are common, especially in the Lepidosaphedini, and the enlarged cephalic ducts are also usually seen. All these facts lead me to the conviction that the Diaspididae lepidosaphediformes must have departed from a quite generalized, primitive form of the Diaspididae parlatoriformes. However, there is known no undoubted intermediate form between these two groups, although this is deservedly expected if the group of the Diaspididae lepidosaphediformes has its origin in the early course of the diaspidid evolution. The informations at hand give me no capital idea of the further relation between the two groups.

In making a discussion on the phylogenetic relation within the Diaspididae I can not pass over the cytological informations accumulated by Brown and others. An interpretation of the chromosomal and taxonomic correlations was presented by Brown and McKenzie (*1962*) on the basis of these informations, but I will try to present here another interpretation in accordance with my system of classification (Table 2). After Brown and others there are three systems of chromosome behavior in the sexual species of the Diaspididae, i.e., the lecanoid, diaspidid and comstockiella systems, and the most probable evolutionary sequence in these systems, assumed from the cytological viewpoint, is: lecanoid→comstockiella→diaspidid. This sequence is supported by the fact that the lecanoid system is common in the Coccoidea, whereas the lecanoid and comstockiella systems occur in the Halimococcidae, Phoenicococcidae and part of the Diaspididae, and the diaspidid system only in the Diaspididae. Moreover, in the Diaspididae the lecanoid system occurs in association with the comstockiella system.

In a total of 131 species of the Diaspididae examined by Brown (1965, Hilgardia 36: 189–294) only 18 species belong to the heterochromatic systems, that is, the lecanoid, comstockiella, or combined lecanoid and comstockiella systems, and other 89 species to the diaspidid system, with the remain undetermined or parthenogenetic. Adopting my scheme of classification the chromosomal and taxonomic correlations may be interpreted as follows. Of the 18 species belonging to the heterochromatic systems six are peculiar forms, of which the exact taxonomic positions are yet unknown, i.e., *Ancepaspis edentata, A. tridentata, Comstockiella sabalis, Costalimaspis eugeniae, Nicholiella bumeliae* and

TABLE 2. Summary of an interpretation of the chromosomal and taxonomic correlations in the palm and armoured scale insect families, based on the cytological informations given by Brown (1965) and the classification scheme of the Diaspididae adopted in this paper.

Taxonomic group	Chromosome number (2n)	Number of species	Chromosome system							
			Sexual						Parthenogenetic	Species containing both sexual and parthenogenetic races
			Lecanoid	Comstockiella and lecanoid	Comstockiella	Heterochromatic (without further determination)	Diaspidid	Undetermined		
Halimococcidae	10	6	1		3	1			1	
Phoenicococcidae										
Phoenicococcus	18	1			1					
Xanthophthalma	16	1							1	
Diaspididae										
Genera incertae sedis										
Ancepaspis	6	1			1					
	8	1		1						
Comstockiella	10	1			1					
Costalimaspis	12	1		1						
Crassaspis	8	1					1			
Nicholiella	8	1		1						
Radionaspis	8	1				1				
Leucaspidini	8	1				1				
	11	1							1	
Parlatorini	8	4		3	1					1
	10	1				1				
Rugaspidiotini	8	1							1	
Odonaspidini	8	2			1				1	
Aspidiotini										
Aonidia	8	2			1		1			
Furchaspis	6	1			1					
	8	1					1			
Neomorgania	8	1				1				
Pseudaonidia	8	2		1		1				
Other genera	8	54					42	3	9	2
	12	1					1			
Diaspididae	6	1					1			
lepidosaphediformes	8	37					30	2	5	1
	10	6					4		2	
	12	3					3			
	16	2					2			
	18	3					3			

Radionaspis indica, and the other 12 species all fall in the Diaspididae parlatoriformes; of these 12 species seven belong to the Leucaspidini, Parlatorini or Odonaspidini, and the other five to the Aspidiotini; and of these five aspidiotines four are more or less primitive in the antennal setae, spiracular disc pores or other characters, belonging to *Furchaspis*, *Neomorgania* and *Pseudaonidia*. After all, the heterochromatic systems are, in the Diaspididae, largely associated with more or less primitive forms of the group Diaspididae parlatoriformes, giving rise to the diaspidid system in the tribe Aspidiotini, which is the most advanced in the Diaspididae parlatoriformes, and also in the group Diaspididae lepidosaphediformes, which may be a derivative from the Diaspididae parlatoriformes.

In ending this discussion, a brief comment should be given on the pupillarial forms of the Diaspididae. It is the opinion generally accepted that most, if not all, of the pupillarial forms have been derived from related non-pupillarial forms. Brown (1965, l. c.), however, noticed that the heterochromatic systems of chromosome behavior are in some degree associated with the pupillarial forms and considered that "there is no particular difficulty in picturing the primitive armored scales as pupillarial and having a Comstockiella system." On the other hand, he met with an obstacle in giving the origin of the non-pupillarial forms to the pupillarial, that is, "if the evolutionary main stem consisted of pupillarial forms, then the beautifully definitive pygidial architecture of the non-pupillarial adult forms···must be a secondary manifestation of pygidial evolution which had been confined to the second stage female." The tribe Leucaspidini is composed wholly of pupillarial genera. In the Parlatorini the pupillarial genera may perhaps far exceed the non-puillarial in number, although the whole composition of the tribe is yet unknown. It is also impossible at present to give the exact number of pupillarial genera for the Aspidiotini and the Diaspididae lepidosaphediformes, but in these groups the pupillarial genera are apparently few in comparison with the non-pupillarial. It is, then, not difficult, as stated by Brown, to picture the primitive armoured scale insects as pupillarial.

Nevertheless, I will not necessarily conclude that "the evolutionary main stem consisted of pupillarial forms". If the pupillarial mode of life has a distinguished advantage in survival—and this is probably true, since the change from the non-pupillarial form to the pupillarial seems to have happened many times in various groups of the family—the proportion of the pupillarial forms to the non-pupillarial would grow larger in a group which is on the decline. The tribe Leucaspidini is a small group, and the existing forms of it are probably relics which have survived possibly owing to the pupillarial mode of life. The tribe Parlatorini may largely be an assemblage of relics. The fact that the existing forms of the Halimococcidae are all pupillarial may be also the result of selective survival. The tribes Rugaspidiotini and Odonaspidini are quite small groups, and the existing forms of these tribes may be survivors of larger groups; these existing forms are all not pupillarial, but it may be significant for their survival that they live usually under the protection of the bark flake, leaf sheath, stipules or other parts of the plant body.

In brief, the Diaspididae parlatoriformes may have first developed, with heterochromatic systems of chromosome behavior, giving rise to the Aspidiotini and the Diaspididae lepidosaphediformes, both these groups having recently developed in a newly acquired chromosome system, the diaspidid system. The old forms with the heterochromatic

systems have been largely replaced by the new forms with the diaspidid system, leaving pupillarial or cryptic forms, which have survived perhaps owing to their mode of life. The primary development of the Diaspididae may have taken place in the Old World, so far as indicated by the distribution of the existing forms of the Leucaspidini and Parlatorini.

After all, the two groups Diaspididae parlatoriformes and Diaspididae lepidosaphediformes are not mere aggregates, but are good phylogenetic stocks, and may be treated as the subfamilies Aspidiotinae and Diaspidinae, respectively. Since many other forms, however, are puzzling as to their taxonomic positions, no formal ranking of these groups is here made*.

A list of the genera and species found in the collection

Group A—**Diaspididae parlatoriformes**

Tribe **Leucaspidini**

I. Genus *Leucaspis* Targ.

1. *L. machili*, n. sp.; 2. *L. incisa*, n. sp.

II. Genus *Lopholeucaspis* Balach.

3. *L. japonica* (Cockll.).

Tribe **Parlatorini**

III. Genus *Parlatoria* Targ.

4. *P. camelliae* Comst.; 5. *P. theae* Cockll.; 6. *P. proteus* (Curt.); 7. *P. arengae*, n. sp.; 8. *P. ziziphi* (Luc.); 9. *P. machili* Takah.; 10. *P. machilicola* Takah.; 11. *P. cinerea* Had.; 12. *P. fluggeae* Hall.

IV. Genus *Parlatoreopsis* Lindgr.

13. *P. chinensis* (Marl.).

V. Genus *Neoparlatoria* Takah.

14. *N. maai*, n. sp.; 15. *N. miyamotoi*, n. sp.

VI. Genus *Silvestraspis* Bell.

16. *S. uberifera* (Lindgr.).

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* In the course of the present discussion I have made no comment on a recent classification of the Diaspididae given by Borchsenius (1965, Ent. Obozr. 44: 362-376). So far as my study goes, I can not adopt his scheme as a whole; and in certain details I can not agree entirely with him. In the present discussion I neglected completely the adult males, although informations on them are available in Ghauri (*1962*) and others. The main reason for this lies in that the adult males are still out of my own study. However, any discussion on higher taxa within the Coccoidea made in neglection of the adult males may go now out of date. I hope for a future opportunity to criticize my classification on the basis of the adult males and other well-arranged informations.

VII. Genus *Mixaspis* Takah.

17. *M. bambusicola* (Takah.).

Tribe **Rugaspidiotini**

VIII. Genus *Smilacicola*, n. g.

18. *S. apicalis*, n. sp.

IX. Genus *Poliaspoides* MacG.

19. *P. formosanus* (Takah.).

Tribe **Odonaspidini**

X. Genus *Odonaspis* Leon.

20. *O. penicillata* Gr.; 21. *O.* sp.

Tribe **Aspidiotini**

XI. Genus *Aspidiotus* Bouché

22. *A. cryptomeriae* Kuw.; 23. *A. destructor* Sign.; 24. *A. beilschmiediae*, n. sp., 25. *A. watanabei*, n. sp.; 26. *A. pothos*, n. sp.; 27. *A. hoyae*, n. sp.; 28. *A. excisus* Gr.

XII. Genus *Taiwanaspidiotus*, n. g.

29. *T. shakunagi* (Takah.); 30. *T. yiei*, n. sp.

XIII. Genus *Hemiberlesia* Cockll.

31. *H. rapax* Comst.; 32. *H. lataniae* (Sign.); 33. *H. cyanophylli* (Sign.); 34. *H. pitysophila*, n. sp.

XIV. Genus *Aonidiella* Berl. et Leon.

35. *A. aurantii* (Mask.); 36. *A. citrina* (Coquil.); 37. *A. inornata* McK.; 38. *A. tsugae*, n. sp.

XV. Genus *Chrysomphalus* Ashm.

39. *C. ficus* Ashm.; 40. *C. bifasciculatus* Ferr.

XVI. Genus *Lindingaspis* MacG.

41. *L. ferrisi* McK.

XVII. Genus *Crassaspidiotus*, n. g.

42. *C. takahashii*, n. sp.

XVIII. Genus *Metaspidiotus* Tak.

43. *M. stauntoniae* (Takah.); 44. *M. machili* (Takah.).

XIX. Genus *Selenomphalus* Mamet

45. *S. euryae* (Takah.).

XX. Genus *Diaonidia* Takah.

46. *D. cinnamomi* (Takah.).

XXI. Genus *Pseudaonidia* Cockll.

47. *P. trilobitiformis* (Gr.).

Genera incertae sedis

XXII. Genus *Thysanaspis* Ferr.

48. *T. perkinsi*, n. sp.

XXIII. Genus *Pygalataspis* Ferr.

49. *P. miscanthi* Ferr.

Group B—**Diaspididae lepidosaphediformes**

Tribe **Lepidosaphedini**

XXIV. Genus *Lepidosaphes* Shim.

50. *L. japonica* (Kuw.); 51. *L. nivalis*, n. sp.; 52. *L. maskelli* Cockll.; 53. *L. tokionis* (Kuw.); 54. *L. gloverii* (Pack.); 55. *L. beckii* (Newm.); 56. *L. cycadicola* Kuw.; 57. *L. yoshimotoi*, n. sp.; 58. *L. machili* (Mask.); 59. *L.* sp.; 60. *L. laterochitinosa* Gr.; 61. *L. pitysophila*, n. sp.; 62. *L. leei*, n. sp.

XXV. Genus *Andaspis* MacG.

63. *A. crawii* (Cockll.); 64. *A. viticis*, n. sp.

XXVI. Genus *Acanthomytilus* Borchs.

65. *A. chui*, n. sp.; 66. *A. vermiformis* (Takah.).

XXVII. Genus *Neopinnaspis* McK.

67. *N. harperi* McK.

XXVIII. Genus *Howardia* Berl. et Leon.

68. *H. biclavis* (Comst.).

Tribe **Diaspidini**

XXIX. Genus *Diaspis* Costa

69. *D. bromeliae* (Kern.).

XXX. Genus *Unaspis* MacG.

70. *U. aei*, n. sp.

XXXI. Genus *Thysanofiorinia* Balach.

71. *T. nephelii* (Mask.).

XXXII. Genus *Duplachionaspis* MacG.

72. *D. divergens* (Gr.).

XXXIII. Genus *Pseudaulacaspis* MacG.

73. *P. pentagona* (Targ.); 74. *P. cockerelli* (Cool.); 75. *P. sasakawai*, n. sp.; 76. *P. megacauda*, n. sp.; 77. *P. takahashii* (Ferr.).

XXXIV. Genus *Epifiorinia*, n. g.

78. *E. tsugae*, n. sp.

XXXV. Genus *Fiorinia* Targ.

79. *F. pinicola* Mask.; 80. *F. japonica* Kuw.; 81. *F. taiwana* Takah.; 82. *F. arengae* Takah.; 83. *F. fioriniae* (Targ.); 84. *F. formosensis* Takah.; 85. *F. linderae*, n. sp.; 86. *F. minor* Mask.; 87. *F. theae* Gr.; 88. *F. proboscidaria* Gr.

XXXVI. Genus *Achionaspis*, n. g.

89. *A. kanoi*, n. sp.

XXXVII. Genus *Chionaspis* Sign.

90. *C. sozanica* Takah.; 91. *C. machili* (Takah.); 92. *C. uenoi*, n. sp.; 93. *C. trochodendri* (Takah.); 94. *C. schizosoma*, n. sp.; 95. *C.* sp.

XXXVIII. Genus *Greenaspis* MacG.

96. *G. elongata* Gr.

XXXIX. Genus *Aulacaspis* Cockll.

97. *A. tubercularis* Newst.; 98. *A. yabunikkei* Kuw.; 99. *A. actinodaphnes*, n. sp.; 100. *A. alisiana*, n. sp.; 101. *A. saigusai*, n. sp.; 102. *A. murrayae* Takah.; 103. *A. greeni* Takah.; 104. *A. maesae*, n. sp.; 105. *A. spinosa* (Mask.); 106. *A. difficilis* (Cockll.); 107. *A. robusta* Takah.; 108. *A. actinidiae*, n. sp.; 109. *A. divergens* Takah.

XL. Genus *Pinnaspis* Cockll.

110. *P. buxi* (Bouché); 111. *P. aspidistrae* (Sign.); 112. *P. muntingi* Tak.; 113. *P. strachani* (Cool.); 114. *P. liui*, n. sp.; 115. *P. shirozui*, n. sp.; 116. *P. hibisci*, n. sp.; 117. *P. frontalis*, n. sp.; 118. *P. uniloba* Kuw.

XLI. Genus *Afiorinia*, n. g.

119. *A. hirashimai*, n. sp.

XLII. Genus *Ichthyaspis*, n. g.

120. *I. ficicola* Takah.

Genera incertae sedis

XLIII. Genus *Kuwanaspis* MacG.

121. *K. pseudoleucaspis* (Kuw.); 122. *K. suishana* (Takah.); 123. *K. vermiformis*

(Takah.); 124. *K. neolinearis* (Takah.).

XLIV. Genus *Megacanthaspis* Tak.

125. *M. litseae*, n. sp.

Descriptions* of the genera and species found in the collection

Group A—**Diaspididae parlatoriformes**

Tribe **Leucaspidini**

I. Genus ***Leucaspis*** Targioni

References. Targioni *1869*: 41; Balachowsky *1953g*: 844.

Synonyms. *Leucodiaspis* Signoret, 1869 and auct. [an invalid name based on a mis-spelling or emendation]; *Rhopaloaspis* Del Guercio, 1903 [type-species: *Leucaspis riccae* Targioni]; *Euleucaspis* Lindinger, 1905 [type-species: *Leucaspis signoreti* Targioni]; *Anamaspis* Leonardi, 1906 [type-species: *Leucaspis loewi* Colvée]; *Actenaspis* Leonardi, 1906 [type-species: *Leucaspis pusilla* Loew]; *Pusillaspis* Lindinger, 1906 [type-species: *Leucaspis pusilla* Loew]; *Maniaspis* Borchsenius, 1964 [type-species: *Maniaspis manii* Borchsenius].

Type-species. *Leucaspis candida* Targioni=*Coccus pini* Hartig.

Diagnosis. Pupillarial, the adult female entirely covered with the second exuvium. Body elongate; free segments little or slightly lobed laterally. Derm membraneous, often with some ornamentations such as dense and fine spicules, delicate scaly granulations (in the median region of the prepygidial ventrum) and small sclerotized patches (on the pygidial dorsum). Pygidial lobes in one to four pairs, small; median lobes separated from each other by a good space. Plates present or absent on the pygidium, if present slender and spiniform, sometimes fimbriate. Gland tubercles absent on the prepygidial abdomen, or if present confined to posterior segments. Dorsal ducts absent, or if present confined within the pygidial margin, quite small in size, with the orifice surrounded by a sclerotized rim. Antennae each with two to six setae. Anterior spiracles with disc pores loosely clustered, and often with small ducts crowded laterally to them, in some species all or part of these ducts being opened in tubercular processes. Anal opening situated about the centre or more or less towards the base of the pygidium. Perivulvar disc pores in five groups; supplementary groups of disc pores often present in front of the pygidium.

Second instar female similar to the adult female in the body-shape. Pygidial lobes in two pairs, short and broad, rounded or flat apically, sometimes distinctly once-notched on each side. Median lobes with a pair of short, broad, fimbriate plates between them, another pair of plates between the median and second lobes, a series of similar plates laterally to the second lobe. Gland tubercles present on the thorax and abdomen. Macroducts not reduced in size, arranged marginally and dorsally. Exuvium enlarged and quite thickly sclerotized.

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* The descriptions are given mainly on the diagnostic characters of the adult instar of the female and unless otherwise stated are concerned with this instar. The descriptions and figures of the species dealt with herein are all based exclusively on specimens found in the present collection.

Composition and distribution. This genus received a number of species from all over the world, but many of them have been removed to other genera. Our recent conception of this genus is based on revisions given by Ferris (*1936 a*; *1942*) and Balachowsky (*1953 g*); the latter author studied in detail seven species from the Palaearctic region and New Zealand. Certain other species described from southeastern Asia are undoubtedly retainable in this genus, which seems to be no more than Palaearctic, Oriental and Australian in distribution.

Remarks. It is the opinion here adopted that *Maniaspis*, which was erected by Borchsenius for two Indian species, should be united with *Leucaspis*. The type-species of *Maniaspis* is particular by having conical, sclerotized, non-glanduliferous processes laterally to the mouth-parts and gland tubercles in the prepygidial region of the abdomen, but in other respects it is retainable in *Leucaspis* defined by Balachowsky. Borchsenius included *Leucaspis gigas* Maskell in *Maniaspis*, but this species has not such particulars.

Takahashi described four species in this genus from Taiwan as given below, but none of them is retainable in the genus.

1) *bambusicola* Takahashi. Type-species of *Mixaspis*.
2) *formosana* Takahashi. Type-species of *Formosaspis*. Not collected.
3) *hydrangeae* Takahashi. Referable to *Lopholeucaspis*. Not collected.
4) *vitis* Takahashi. Not collected.

1. ***Leucaspis machili***, n. sp. [Fig. 2; 3]

Diagnosis. Body elongate-pyriform, with the pygidium rounded. Derm finely and densely spiculous, especially so on the pygidium and posterior prepygidial segments; median region of the prepygidial ventrum posteriorly to the mouth-parts with delicate scaly granulations and with microducts scattered; pygidial dorsum with six or seven sclerotized patches on each side. Pygidial lobes in two pairs, conical, their bases extruding onto the pygidium; median lobes widely separated from each other; second lobes smaller than the median. Plates absent, but the pygidial margin crenulate with rudimentary conical processes, some of them associated with microducts on the base of the pygidium. Dorsal marginal seta between the median and second lobes much elongate. Dorsal ducts absent. Antenna with five setae. Anterior spiracle with about 10 disc pores, and with 20 to 26 small ducts crowded laterally in a longitudinal cluster. Perivulvar pores: six to 10 in the median group, eight to 14 in the anterolateral and six to eight in the posterolateral; a small supplementary submarginal group on the preceding two segments each, containing two to five disc pores.

Specimens examined. Yang-ming Shan, on *Machilus japonica*; Chu-chi, on *Machilus* sp.; Ken-ting, on *Machilus kusanoi*.

Remarks. This species comes close to *Leucaspis manii* Borchsenius (=*Maniaspis manii*) from India, but it may be distinguishable from the latter by lacking conical, sclerotized, non-glanduliferous processes laterally to the mouth-parts, by lacking gland tubercles, and by lacking dorsal ducts on the apex of the pygidium.

2. ***Leucaspis incisa***, n. sp. [Fig. 4; 11 A]

Diagnosis. Body elongate, about four times as long as wide, with the pygidium rather of the shape of a trapezoid. Derm membraneous, with fine and dense spicules

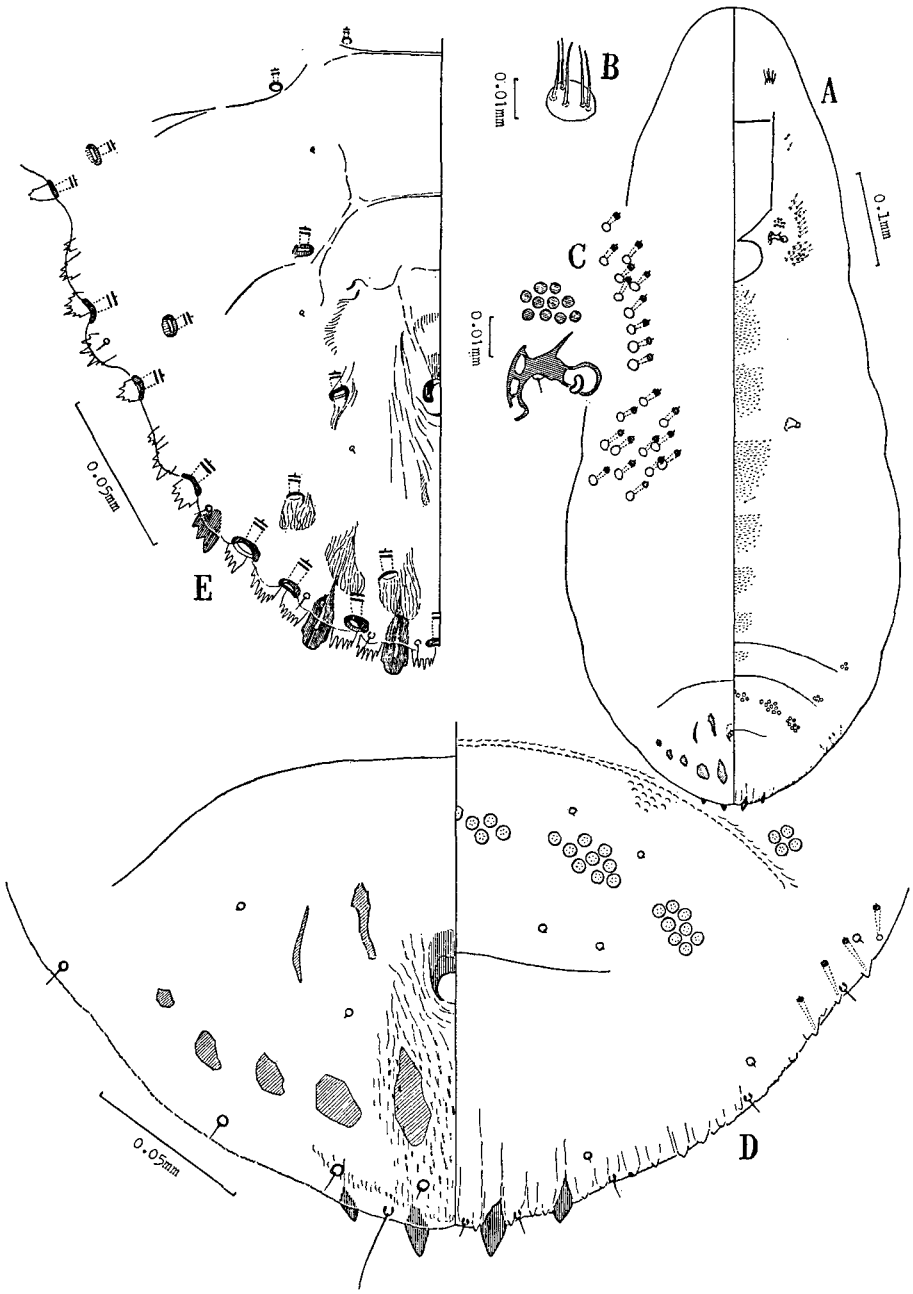

Fig. 2. *Leucaspis machili*, n. sp. A–D, adult female (A, body; B, antenna; C, anterior spiracle with disc pores and ducts; D, pygidium); E, pygidium of the exuvium of the second instar female in dorsal view.

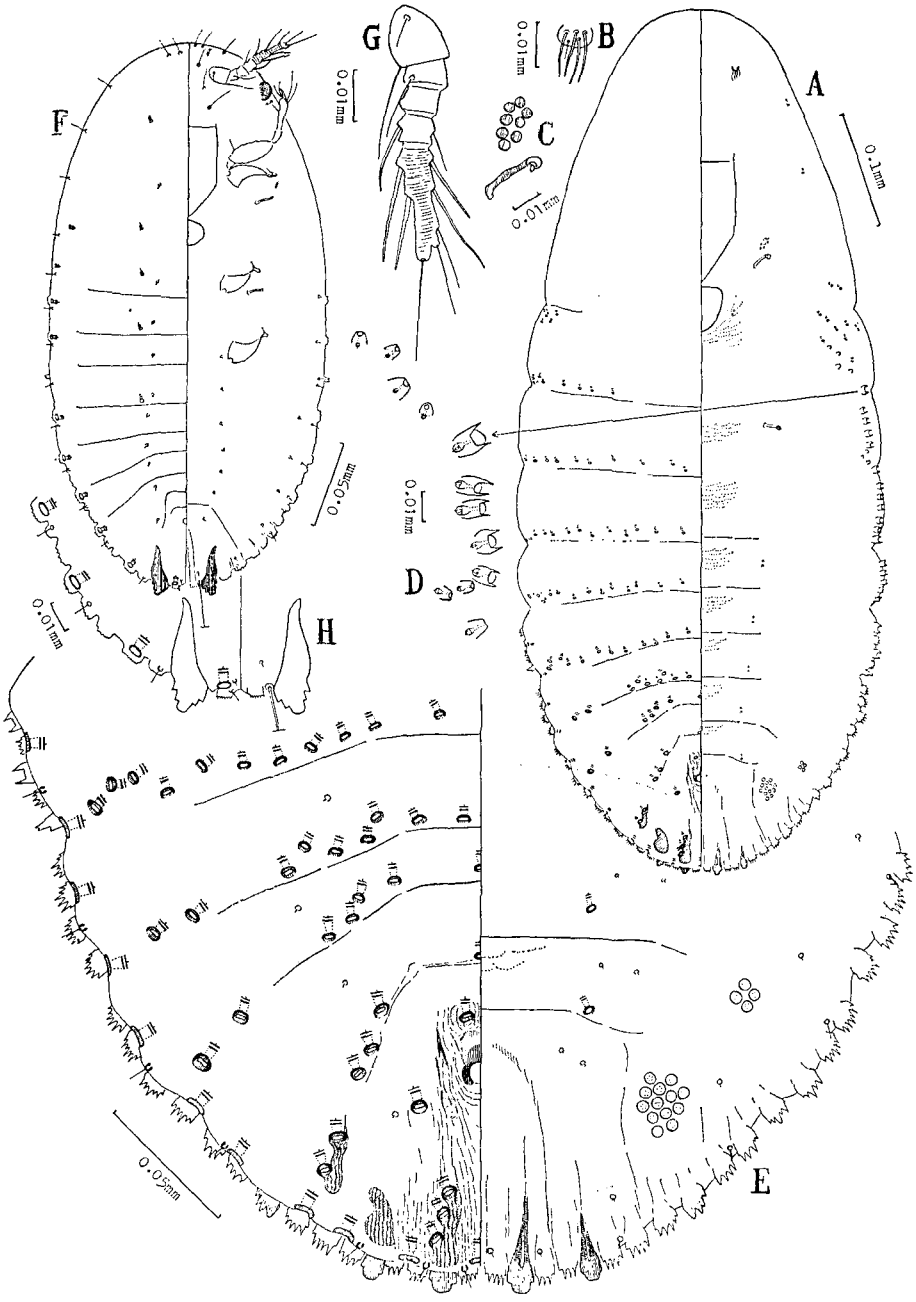

Fig. 3. *Leucaspis machili*, n. sp. A–E, second instar male (A, body; B, antenna; C, anterior spiracle; D, gland tubercles; E, pygidium); F–H, first instar larva (F, body; G, antenna; H, posterior extremity of the body).

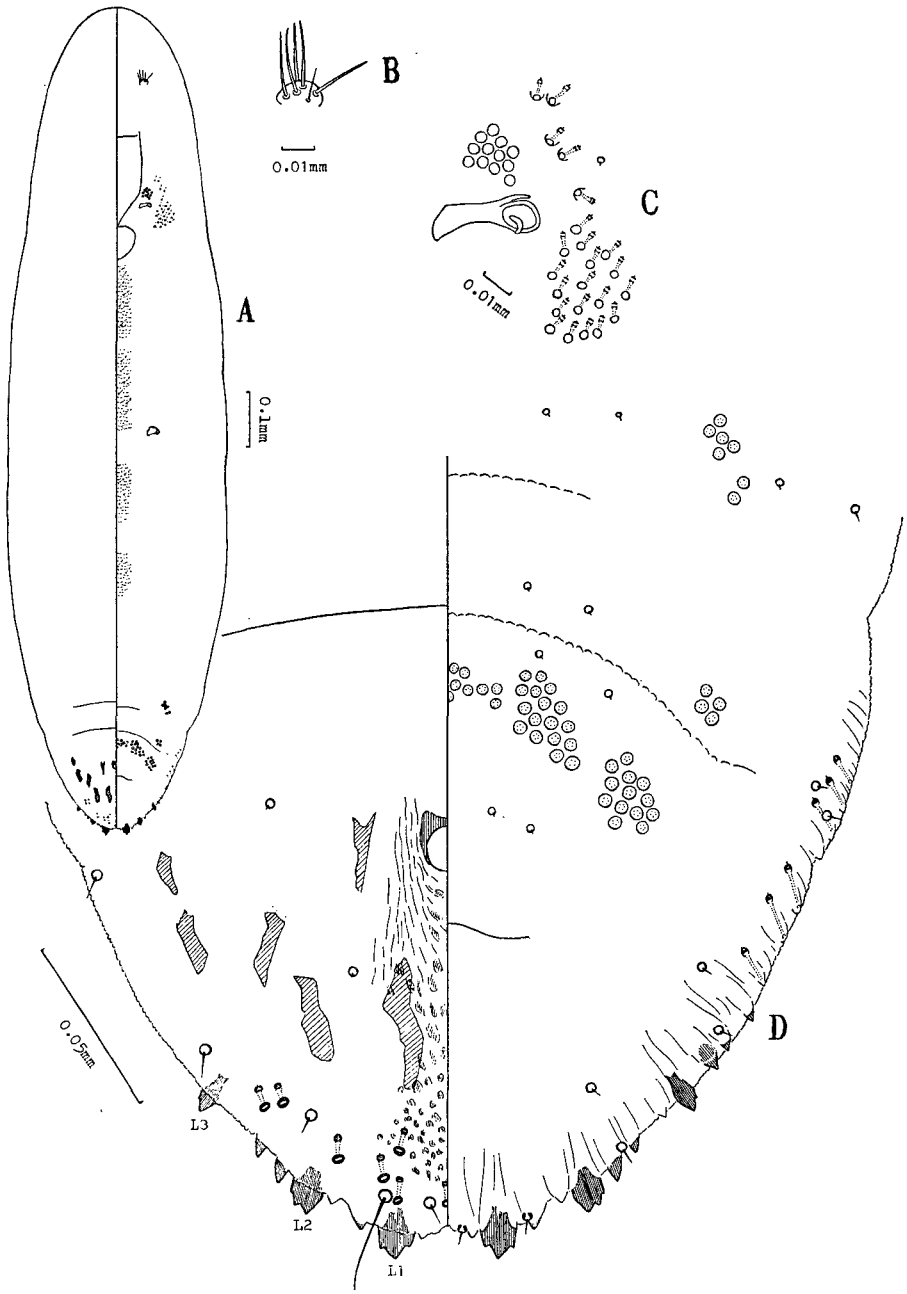

Fig. 4. *Leucaspis incisa*, n. sp. Adult female (A, body; B, antenna; C, anterior spiracle with disc pores and ducts; D, pygidium).

especially on the pygidium and posterior prepygidial segments; median region of the ventrum between the mouth-parts and the base of the pygidium with delicate scaly granulations in a narrow, segmentally interrupted, longitudinal band, and with microducts scattered among the granulations. Pygidial dorsum with six sclerotized patches on each side. Pygidial lobes in three pairs; median lobes widely separated from each other, as long as wide, pointed apically, and deeply once-notched on each side; second lobes as large as or a little smaller than the median; third lobes much smaller, divergent, rather conical. Pygidial margin with sclerotized, conical processes, of which some are rudimentary and glanduliferous on the base of the pygidium. A much elongate marginal dorsal seta just laterally to the median lobe. Some dorsal ducts (11 in total) scattered within the apical margin of the pygidium, with the rim of the orifice thickly sclerotized and as large as or a little smaller than the alveoli of the neighbouring setae. Antenna with five fleshy setae. Anterior spiracle with 12 disc pores, and with 23 small ducts laterally in a longitudinal cluster. Perivulvar pores: 15 in the median group, 17 to 20 in the anterolateral and 11 to 13 in the posterolateral; a small supplementary submarginal group on the preceding two segments each, the anterior group with seven or eight disc pores and the posterior with four.

Specimens examined. Yang-ming Shan, on *Machilus japonica* [a single adult female with the first and second exuvia].

Remarks. This species differs from the preceding (*machili*, n. sp.) by having three pairs of incised pygidial lobes and by having dorsal ducts on the pygidium. In other respects the two are very close. This species was collected on the leaf of the host plant, whereas *machili* on the woody parts.

II. Genus ***Lopholeucaspis*** Balachowsky

References. Balachowsky *1953g*: 875; ibid., *1958b*: 335; Borchsenius 1964, Ent. Obozr. 43: 865.

Type-species. *Leucaspis japonica* Cockerell.

Diagnosis. Pupillarial, the adult female being entirely covered with the second exuvium. Body elongate fusiform, with the head elongate in front of the mouth-parts, and with the pygidium rounded; free segments little lobed laterally. Derm membraneous, with delicate scaly processes in the whole median region of the prepygidial ventrum posteriorly to the mouth-parts, and with some sclerotized patches on the pygidial dorsum. Pygidial lobes well developed in two pairs, conical; median lobes separated from each other by a good space, with a pair of quite slender, apically fimbriate plates between them, these plates about as long as or longer than the lobes. A pair of similar plates between the median and second lobes. Shorter and broader plates laterally to the second lobe, more or less tubercular towards the base of the pygidium, giving way to a row of apically truncated gland tubercles, this row attaining the anterior end of the mouth-parts, with microducts scattered along it. Ducts all small, with the orifice surrounded by a sclerotized rim, those on the pygidial dorsum being a little larger than the ventral microducts and scattered. Antennae far removed from the anterior extremity of the body, each with three to five setae. Anterior spiracles with disc pores rather loosely clustered. Anal opening rounded, towards the base of the pygidium. Perivulvar pores in five groups, the median and anterolateral

groups often united; a small supplementary group of disc pores present in the submarginal region of the two preceding segments each.

Second instar female similar to the adult female in the body-shape. Pygidial lobes in two pairs, short and broad, with a deep notch on each side, the base of each lobe extending onto the pygidial ventrum in the shape of a wedge. Median lobes with a pair of short, broad, well-fimbriate plates between them; another pair of plates between the median and second lobes; a series of similar plates laterally to the second lobe, reducing towards the base of the pygidium, giving way to a row of gland tubercles, which extends onto the prosoma. Macroducts not reduced in size, arranged marginally and dorsally. Exuvium enlarged, heavily sclerotized and highly convex.

Composition and distribution. This genus was originally established for *Leucaspis japonica* Cockerell and *L. cockerelli* Charmoy, which have been recorded widely in the world. The latter species, however, seems to be constricted to the tropics and subtropics. After Borchsenius, *Leucaspis limoniae* Rutherford, originally described from Ceylon, and *L. japonica* var. *darwiniensis* Green, originally described from Australia, are distinct species of this genus. Two other species, *excoecariae* and *menoni*, were described by him from India. *Leucodiaspis hydrangeae* Takahashi, which was originally described from Taiwan, may be also a good species belonging to this genus.

3. ***Lopholeucaspis japonica*** Cockerell [Fig. 11 B]

References. Cockerell *1897 d*: 53 [*Leucaspis*]; Balachowsky *1953 g*: 877. Described by many authors in *Leucaspis*.

Synonyms. *Leucaspis japonica* var. *darwiniensis* Green, 1916, was synonymized with the present species by authors. Balachowsky assumed that *Leucodiaspis hydrangeae* Takahashi, 1934, is identical with the present species, but I have some doubt about this identity.

Diagnosis. Body about three times as long as wide. Pygidial lobes sometimes once-notched on one or either side; second lobes a little smaller than the median. Plates quite slender between the median lobes and between the median and second, one to three plates occurring just laterally to the second lobe shorter and broader and apically fimbriate; are practically obsolete or represented by low tubercular prominences towards the base of the pygidium. Pygidial dorsum with seven to nine sclerotized patches of derm on each side in the submarginal region and another slender patch on each side of the anal opening; with abundant ducts (about 35 in number on each side) scattered practically on the whole surface. Ventral microducts scattered across the base of the pygidium and the preceding abdominal segments. Anterior spiracle with 11 to 20 disc pores. Perivulvar pores rather numerous, 36 to 55 in the united median and anterolateral groups, 15 to 24 in the posterolateral; four to 10 supplementary disc pores on the penultimate, and five to eight on the ultimate prepygidial segment on each side.

Specimens examined. Yeh-liu, on *Pittosporum tobira* [in poor condition]; Tai-pei, on *Liquidambar formosana*; A-li Shan, on *Eurya crenatifolia* and *Rhododendron* spp.

Distribution and host plants. This species was originally described from specimens found on broom from Japan and later recorded from various kinds of plants at many localities of the world.

Tribe **Parlatorini**

III. Genus ***Parlatoria*** Targioni

References. Targioni *1968*: 42; Ferris *1937*: 84; Morrison *1937 a*; McKenzie *1945*; Bala-

chowsky *1953g*: 773; ibid., *1958b*: 320.

Synonyms. *Apteronidia* Berlese, 1895 [type-species: *Coccus blanchardii* Targioni]; *Websteriella* Leonardi, 1900 [type-species: *Coccus zizyphi* Lucas]; *Euparlatoria* Leonardi, 1903 [type-species: *Parlatoria calianthina* Berlese and Leonardi=*Diaspis oleae* Colvée]; *Parlatorea* Lindinger, 1905 [an emendation of *Parlatoria*]; *Archangelskaia* Borchsenius, 1951 [type-species: *Parlatoria ephedrae* Lindinger].

Type-species. *Aspidiotus proteus* Curtis.

Diagnosis. Body subcircular to oval in outline, with the lateral lobes of the free segments distinct but not strongly produced, and with the pygidium rounded or rather triangular. Derm remaining membraneous except for the pygidium. Granulations or minute scaly processes of the derm present just posterolaterally to the mouth-parts in some species (peribuccal granulations). A small membraneous invagination of the derm (derm pocket) present in some species between the posterior spiracle and body margin. Three pairs of pygidial lobes developed; the fourth and fifth lobes each represented by an angular sclerotized process or replaced by a plate-like membraneous process. Plates extending not far beyond the apices of the lobes, occurring between the median lobes and around the whole lateral margin of the pygidium; prepygidial plates tending to be reduced into tubercular processes. Ventral submarginal gland tubercles present in many species and basically in five groups: prespiracular group situated anteriorly to the level of the anterior spiracle, the anterior spiracular opposite the anterior spiracle, the mesothoracic, the metathoracic and the first abdominal. Dorsal macroducts short and broad, with a thick, sclerotized rim around the orifice; marginal macroducts of the pygidium larger, in most species with the axis of the orifice roughly parallel to the pygidial margin, one present or absent between the median lobes. Submarginal dorsal macroducts usually present, scattered in a broad, continuous, irregular row on each side of the abdomen. Submedian dorsal macroducts present or absent. Antennal tubercles small, each with a single seta. Prosomatic tubercles present or absent. Anterior spiracles with disc pores, the posterior with none. Anal opening situated about the centre of the pygidium. Perivulvar pores present. Certain species are practically pupillarial, but have little or a comparatively slight tendency towards the structural degeneration of the adult female.

Composition and distribution. This genus, which was revised by McKenzie and other recent authors, comprises a good number of species distinctly centred in south-eastern Asia, with extensions into Australia and Africa. Some species are widely distributed in the tropics and other warm parts of the world presumably through human agencies.

Remarks. So far as I am aware the following 11 species have been known to occur in Taiwan. In the present collection are found nine species, of which two (*fluggeae*; *theae*) may be new to the fauna of Taiwan and another is described as a new species hereinafter.

1) *camelliae* Comstock.
2) *cinerea* Hadden.
3) *crotonis* Douglas. Not collected.
4) *lithocarpi* Takahashi. Not collected.
5) *machili* Takahashi.
6) *machilicola* Takahashi.
7) *mytilaspiformis* Green. Not collected.

8) *pergandii* Comstock. Not collected.
9) *proteus* (Curtis).
10) *virescens* Maskell. Not collected.
11) *ziziphi* (Lucas).

In his revision of the genus McKenzie (*1945*) divided the members of *Parlatoria* into five groups, with some isolated species. His *proteus*-group is too large and includes diverse species, whereas he set *machili* apart from *machilicola*, which are very possibly closely related. A trial is made to divide the nine species from the present collection into four groups, the *proteus*-, *ziziphi*-, *machili*-, and *cinerea*-group.

Proteus-group

This group as here understood is, in comparison with the *proteus*-group of McKenzie, restricted within a narrower limit, comprising basic or generalized forms of the genus. The characters possessed in common by the species of the group should be given here for convenience: Pygidium rounded, with the median to third lobes all similar in shape and practically parallel to the longitudinal axis of the body; median lobes well separated from each other, symmetric or nearly so, with a subapical notch on each side, the second and third with the inner notch less distinct or obsolete, all these lobes with a pair of slender basal scleroses. Plates well fimbriate on the pygidium; two between the median lobes, two between the median and second, and three between the second and third all slender; three between the third and fourth (or replaced process of the fourth) and three between the fourth and the basal border of the pygidium broader; prepygidial plates progressively less fimbriate and diminishing in size from the posterior to the anterior, ending in one or a few plates at the posterolateral corner of the first abdominal segment. Gland tubercles complete or nearly so. A marginal macroduct in each interlobar space (L 1–L 1; L 1–L 2; L 2–L 3), two between the third and fourth lobes and also between the fourth and the basal border of the pygidium; prepygidial abdominal segments all with macroducts, the metathorax with one or a few at the posterolateral corner. Submarginal dorsal macroducts in a continuous row extending into the prepygidial region of the abdomen, absent in front of the median interlobar space (L 1–L 1). Submedian dorsal macroducts usually absent. Prosomatic tubercles quite small and sclerotized.

4. ***Parlatoria camelliae*** Comstock [Fig. 11 C]

References. Comstock *1883*: 144 [*pergandii* var.]; Morrison *1939 a*: 8; Ferris *1942*: 400; McKenzie *1945*: 58; Balachowsky *1953 g*: 797; ibid. *1958 b*: 324.

Diagnosis. Body broadly oval. Derm pockets present. Pygidial lobes (L 1–L 3) all practically same in size, the second and third being slightly smaller than the median. Fourth lobe in a small, angular, serrate, sclerotized process; fifth lobe similar to the fourth, but less sclerotized. Gland tubercles: one to five (usually two or three) prespiraculars, two to four anterior spiraculars, four to eight mesothoracics, four to seven metathoracics, and four to eight first abdominals. Row of submarginal macroducts comparatively narrow, containing 13 to 24 macroducts on each side, and extending anteriorly as far as the second abdominal segment. A short row of two to four submedian dorsal microducts on the basal border of the pygidium. Prosomatic tubercles rounded. Anterior spiracle with two to four disc pores. Perivulvar pores absent in the median group, five to seven in the anterolateral and four to eight in the posterolateral.

Specimens examined. Tai-pei Hsien, on *Gordonia axillaris* and *Rhododendron ellipticum*; Heng-chun, on *Calophyllum inophyllum* and *Ficus cuspidatocaudata*; Kenting on *Machilus kusanoi*.

Distribution and host plants. This species is widely distributed in the tropics and other warm parts of the world, feeding on a long list of plants.

5. ***Parlatoria theae*** Cockerell [Fig. 11 D]

References. Cockerell *1896 h*: 21; Morrison *1939 a*: 25; Ferris *1942*: 403; McKenzie *1945*: 74; Balachowsky *1953 g*: 813; ibid. *1958 b*: 331.

Synonyms. The followings were synonymized with this species by authors: *Parlatoria theae* var. *viridis* Cockerell, 1896; *Parlatoria theae* var. *euonymi* Cockerell, 1897; and *Parlatoria pergandei* var. *dives* Bellio, 1929.

Diagnosis. Body broadly oval. Peribuccal granulations present. Derm pockets present. Pygidial lobes progressively smaller from the median to the third, but not much; fourth and fifth each in a small, sclerotized, angular, serrate process. Gland tubercles: two to four prespiraculars, two to four anterior spiraculars, six to 14 mesothoracics, six to 13 metathoracics, and seven to 10 first abdominals. Row of submarginal macroducts extending anteriorly as far as the first or second abdominal segment, containing 32 to 55 macroducts on each side. A short row of one to seven submedian dorsal microducts on the basal border of the pygidium. Prosomatic tubercles rounded. Anterior spiracle with two to four disc pores. Perivulvar pores absent in the median group, nine to 17 in the anterolateral, and 10 to 15 in the posterolateral.

Specimens examined. A-li Shan, on *Trochodendron aralioides*.

Distribution and host plants. This species is widely distributed over the world, feeding on various kinds of plants. So far as I am aware, however, there has been made no authentic record of its occurrence in Taiwan.

6. ***Parlatoria proteus*** (Curtis) [Fig. 12 A]

References. Curtis *1843 b* [*Aspidiotus*]; Ferris *1937*: 89; Morrison *1939 a*: 22; McKenzie *1945*: 72; Balachowsky *1953g*: 810.

Synonyms. *Parlatoria orbicularis* Targioni, 1869, and *Aspidiotus targionii* Del Guercio, 1894, were synonymized with the present species.

Diagnosis. Body subcircular. Derm pockets present. Pygidial lobes progressively smaller from the median to the third. Fourth lobe replaced by a membraneous, plate-like process, smaller than the adjacent plates. Gland tubercles: none or one prespiracular, one anterior spiracular, two to four mesothoracics, three to five metathoracics, and two to four first abdominals. Row of submarginal macroducts comparatively narrow, extending anteriorly as far as the second or third abdominal segment, and containing eight to 20 macroducts on each side. A short row of two to five submedian dorsal microducts present on the basal border of the pygidium; another row of two to four microducts within the pygidial border. Prosomatic tubercles pointed apically. Anterior spiracle with one or two disc pores. Perivulvar pores absent in the median group, five to seven in the anterolateral, and four to six in the posterolateral.

Specimens examined. Heng-chun, on *Podocarpus* sp. (*macrophyllus*?).

Distribution and host plants. This species has been recorded widely in the world on various kinds of plants. In Taiwan it was recorded by Takahashi from the following plants: *Chrysalidocarpus lutescens*, *Citrus* spp., *Cymbidium sinense*, *Dendrobium* spp., *Mangifera indica*, *Monstera deliciosa*, *Osmanthus* sp., *Phalaenopsis amabilis* and *Vitis* sp.

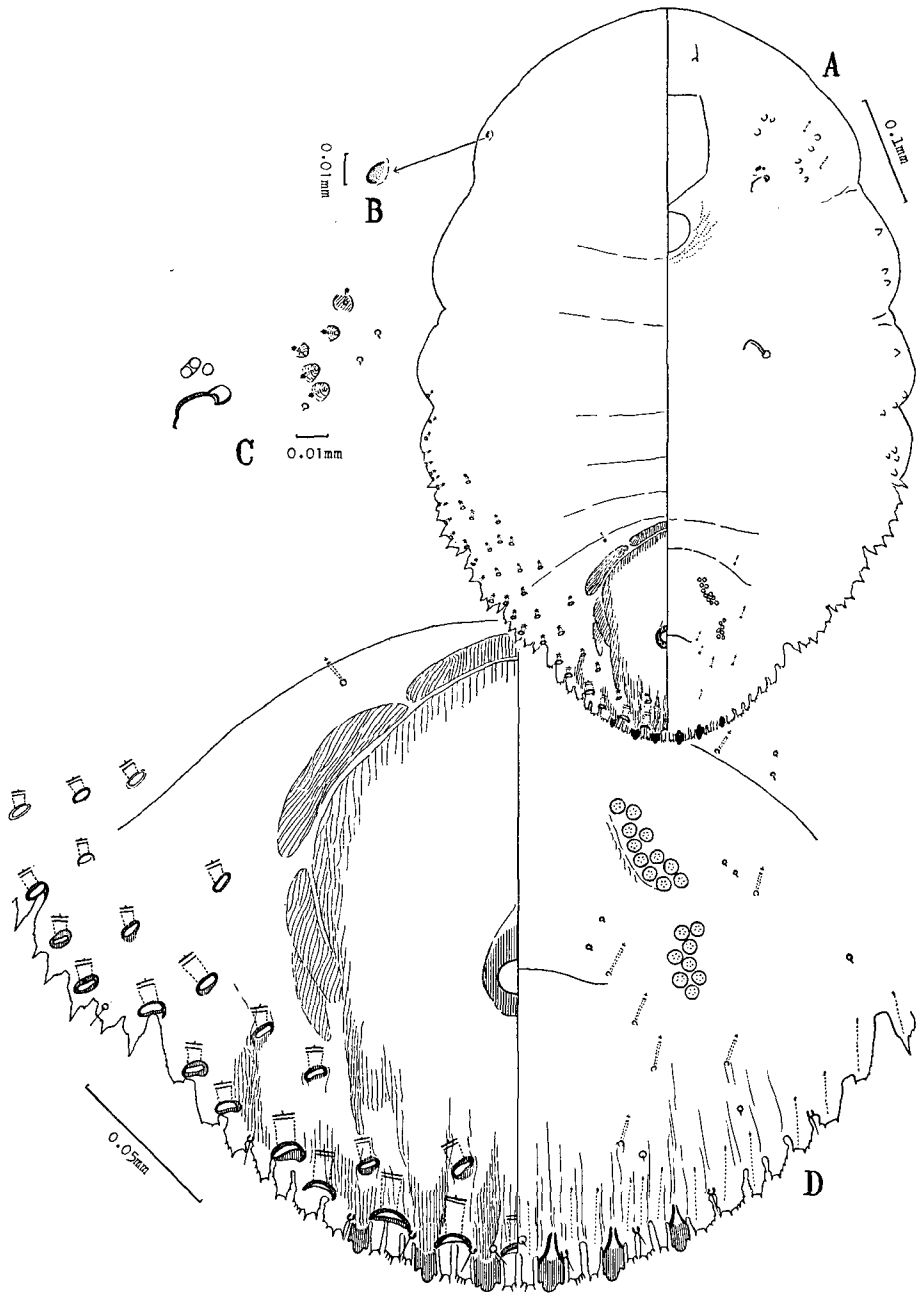

Fig. 5. *Parlatoria arengae*, n. sp. Adult female (A, body; B, prosomatic tubercle, C, anterior spiracle and gland tubercles; D, pygidium).

7. ***Parlatoria arengae***, n. sp. [Fig. 5; 12 B]

Diagnosis. Body oval. Peribuccal granulations present. Derm pockets absent. Median lobes longer than wide, little dilated, with a deep subapical notch on the outer side, and with a less distinct notch on the inner side slightly more apically; second lobes practically as large as the median, the third evidently smaller, these lateral lobes often lacking the inner notch. Fourth lobe replaced by a membraneous process, not distinguishable in shape from the adjacent glanduliferous plates. Gland tubercles: two to nine prespiraculars, three to nine anterior spiraculars, three to 10 mesothoracics, three to 10 metathoracics, and one to four first abdominals. Row of submarginal macroducts comparatively narrow, extending anteriorly as far as the second abdominal segment, and containing 12 to 22 macroducts on each side. Prosomatic tubercles rounded. Anterior spiracle with two to five disc pores. Perivulvar pores absent in the median group, eight to 12 in the anterolateral, and eight to 11 in the posterolateral.

Specimens examined. Tai-pei Hsien and Ken-ting, on the leaves of *Arenga engleri*.

Remarks. This species is close to *proteus*, from which it is distinguishable by the prosomatic tubercles rounded (produced into a spiniform process in *proteus*), by the gland tubercles complete, not disappearing in any group and tending to be more numerous, by the derm pockets absent, by the perivulvar pores more numerous, and by the pygidial lobes little dilated.

Ziziphi-group

This group is represented only by *ziziphi*. This species is similar to the species of the *proteus*-group, but uniquely characterized by having enlarged prosomatic tubercles, which are membraneous and produced laterally like ears.

8. ***Parlatoria ziziphi*** Lucas [Fig. 12 C, D]

References. Lucas *1853*: 28 [*Coccus*]; Ferris *1937*: 90 [*ziziphus*]; Morrison *1939a*: 27 [*zizyphus*]; McKenzie *1945*: 76 [*zizyphus*]; Balachowsky *1953g*: 779; ibid. *1958b*: 332.

Synonyms. The followings were synonymized with the present species by authors: *Chermes aurantii* Boisduval, 1867; *Parlatoria lucasii* Targioni, 1868; and *Mytilaspis flavescens* Milazzo, 1880. The original name *ziziphi* was emended and used as follows by authors: *ziziphus*, *zizyphi* and *zizyphus*.

Diagnosis. Body oval, with the pygidium rounded. Peribuccal granulations present. Derm pockets absent. Median to third lobes practically same in shape and size, longer than wide, constricted basally, with a notch on each side; median lobes well separated from each other; second lobes slightly and the third evidently divergent, all these lobes each with a pair of slender basal scleroses. Fourth lobe in a narrowly conical, thickly sclerotized process, much shorter than the adjacent plates; fifth lobe similar to the fourth or reduced into a membraneous process. Plates occurring anteriorly as far as the second abdominal segment. Gland tubercles absent in the prespiracular and anterior spiracular groups; three to five mesothoracics; five or six metathoracics mingled with about 10 microducts; three to five first abdominals mingled with about five or six microducts. One or two submarginal macroducts just in front of the space between the median lobes, 10 to 22 irregularly scattered on each side anteriorly as far as the third abdominal segment. Prosomatic tubercles each enlarged in a rounded, ear-like process opposite the anterior spiracle. Anterior spiracle with two to five disc pores. Perivulvar pores absent in the median group, five to seven in the anterolateral, and

nine or 10 in the posterolateral. First and second exuvia shining black, the latter enlarged, wholly covering the adult female.

Distribution and host plants. Lucas described *Coccus ziziphi* on *Ziziphus pinna-christi*, whereas Signoret identified a scale insect occurring on orange tree with *Parlatoria ziziphi* (Lucas). This identification has been adopted by authors, and the present species has been recorded under this name or under the three emended names from various localities of the tropics and subtropics as a feeder of *Citrus* plants. Ferris (*1950 a*) recorded it on *Ligustrum* sp. in Yunnan, China.

Machili-group

This group comprises *machili* and *machilicola*, both from Taiwan. The two species are diverse in some characters but are commonly characterized by the enlarged prosomatic tubercles, which are rounded, somewhat sclerotized and situated within the body margin. They are identical also in the pygidial lobes all lacking basal scleroses, in the plates all narrow, in the gland tubercles incomplete, disappearing in some groups, and in the antennal tubercles spinose, with some small processes. Submarginal dorsal macroducts present or absent. Submedian dorsal macroducts absent. Second exuvium enlarged, covering the adult female.

9. ***Parlatoria machili*** Takahashi [Fig. 13 A]

References. Takahashi *1931 a*: 218; McKenzie *1945*: 66.

Diagnosis. Body broadly oval, abruptly narrowed at the base of the pygidium, with the pygidium little rounded. Peribuccal granulations well developed. Derm pockets absent. Median lobes separated from each other by about the width of one of them, slightly divergent, a little longer than wide, deeply notched on each side, with the apex acute. Second lobes similar in shape to the median, but evidently smaller, with the inner notch less distinct. Third lobes much smaller, pointed apically. Fourth lobe in a broad, serrate or apically pointed, membraneous process. Plates all slender; two between the median lobes, two between the median and second, two or three between the second and third, all these plates fimbriate apically; two or three plates between the third and fourth lobes and two laterally to the fourth similar, but some of them may be deformed to low, broad, serrate processes; prepygidial plates blunt apically, occurring anteriorly as far as the second abdominal segment. Gland tubercles absent in the prespiracular and mesothoracic groups; one anterior spiracular, two or three metathoracics, and two or three first abdominals. A marginal macroduct in each interlobar space (L 1–L 1; L 1–L 2; L 2–L 3), one or two between the third and fourth lobes and also between the fourth and the basal border of the pygidium; prepygidial marginal macroducts occurring anteriorly as far as the metathorax. Submarginal macroducts absent, or if present one or two towards the base of the pygidium. Many ventral microducts just laterally to the mouth-parts and also posteriorly to the anterior spiracles. Antennal tubercles spinose, with some samll processes. Prosomatic tubercles enlarged, rounded and sclerotized, within the body margin somewhat anteriorly to the level of the anterior spiracles. Anterior spiracle with two to four disc pores. Perivulvar pores absent in the median group, six to 10 in the anterolateral, and five or six in the posterolateral.

Specimens examined. Yang-ming Shan, on *Machilus japonica* [one adult female];

Chu-chi, on *Machilus* sp. [one adult female].

Distribution and host plants. This species is known to occur only in Taiwan, feeding on *Machilus* spp.

10. ***Parlatoria machilicola*** Takahashi [Fig. 13 B, C]

References. Takahashi *1933*: 52; McKenzie *1945*: 66.

Diagnosis. Body oval, with the pygidium broadly rounded. Derm pockets absent. Median lobes well developed, separated from each other by the width of one of them, a little divergent, each longer than wide, with the lateral margins practically parallel and with a slight subapical notch on each side. Second and third lobes smaller, less sclerotized, practically parallel to the longitudinal axis of the body; second lobes similar in shape to the median, but often notched several times on the outer side; the third serrate on the oblique outer margin. Fourth and fifth lobes each replaced by a broad, serrate, membraneous process, much shorter than the adjacent plates. Plates all elongate; two between the median lobes, two between the median and second, and three between the second and third all slender and fimbriate; three between the third and fourth lobes and two or three laterally to the fourth more or less broader, constricted basally, and serrate on both sides. Prepygidial plates slender and less fimbriate, ended anteriorly with one at the posterolateral corner of the first abdominal segment. Gland tubercles absent in the prespiracular and mesothoracic groups; none or one anterior spiracular, two to four metathoracics, and two to four first abdominals. A marginal macroduct between the median and second lobes and also between the second and third, absent between the median lobes; two between the third lobe and the replaced process of the fourth, two or three or at times more between the fourth lobe and the basal border of the pygidium; prepygidial marginal macroducts occurring anteriorly as far as the posterolateral corner of the metathorax, giving way to some small submarginal ventral macroducts on this segment. Submarginal dorsal macroducts in a comparatively narrow row extending anteriorly as far as the second or third abdominal segment, 13 to 21 on each side. Antennal tubercles spinose, with small processes. Prosomatic tubercles enlarged, rounded and sclerotized, within the body margin slightly anteriorly to the level of the anterior spiracles. Anterior spiracle with three to six disc pores. Perivulvar pores absent in the median group, seven to 10 in the anterolateral, and four to nine in the posterolateral.

Specimens examined. Fen-chi-hu, on *Machilus* sp.; Ken-ting, on *Machilus kusanoi*.

Distribution and host plants. This species occurs only in Taiwan, feeding on *Machilus* spp.

Cinerea-group

This division is identical with McKenzie's *cinerea*-group, comprising advanced forms, in which the median lobes are set close and the plates are more or less reduced. Pygidium rather triangular, with the lobes asymmetrical and convergent. Each lobe with the outer margin oblique and notched or serrate, and without basal scleroses. Gland tubercles complete or nearly so, present in all or most of the five groups. Submarginal dorsal macroducts abundant. Submedian dorsal macroducts present or absent. Prosomatic tubercles absent.

11. ***Parlatoria cinerea*** Hadden [Fig. 13 D]

References. Doane and Hadden *1909*: 299; Morrison *1939a*: 10; McKenzie *1945*: 59; Balachowsky *1935g*: 817.

Synonyms. *Parlatoria pseudopyri* Kuwana and Muramatsu, 1932; *Parlatoria fluggeae* var. *brasiliensis* da Costa Lima, 1934.

Diagnosis. Body subcircular to broadly oval. Peribuccal granulations present. Derm pockets absent. Median lobes robust, about as long as wide, with a subapical notch on the inner side and with several notches on the outer side; second and third lobes similar in shape to the median, but not notched on the inner side, progressively much smaller. Fourth lobe in a broad, low prominence, often serrate. Plates little or poorly fimbriate; two between the median lobes, two between the median and second, and three between the second and third all quite slender; three between the third and fourth lobes broader, each produced apically into a linear elongation; three laterally to the fourth similar, but broader basally, more or less conical; prepygidial plates more or less conical, the anteriormost at the posterolateral corner of the first abdominal segment. Gland tubercles: one to three prespiraculars, one to six anterior spiraculars, two to four mesothoracics, one to three metathoracics and one or two first abdominals. A marginal macroduct in each interlobar space (L1–L1; L1–L2; L2–L3), with the oral rim quite thickened; two between the third and fourth lobes and also between the fourth and the basal border of the pygidium; prepygidial marginal macroducts occurring anteriorly as far as the posterolateral corner of the metathorax, giving way to submarginal ventral macroducts scattered in the posterolateral corner of the metathorax and on the first abdominal segment. Submarginal dorsal macroducts abundant, about 50 in number on each side, in a broad row extending anteriorly as far as the second abdominal segment; about three or four submedian dorsal macroducts in a longitudinal row just laterally to the anal opening and also in another row within the lateral border of the dorsal sclerotization of the pygidium, both rows often joined with the submarginal row. Many ventral microducts in a transverse row between the posterior spiracle and body margin. Anterior spiracle with four to 11 disc pores in a loose transverse row. Perivulvar pores absent in the median group, 10 to 15 in the anterolateral, and 10 to 14 in the posterolateral.

Specimens examined. Chu-chi, on orange tree.

Distribution and host plants. This species has been recorded from various localities in the tropics mainly as a feeder of orange. After Morrison it feeds also on some other plants such as jasmine, *Viburnum*, *Mangifera*, *Bougainvillea*, rose, gardenia, etc.

12. ***Parlatoria fluggeae*** Hall [Fig. 14 A]

References. Hall *1929a*: 329; McKenzie *1945*: 64; Balachowsky *1953g*: 808; ibid. *1958*: 328.

Diagnosis. Body subcircular to broadly oval. Peribuccal granulations present. Derm pockets absent. Median lobes robust, a little longer than wide, with a subapical notch on the inner side and with one or several notches on the outer side; second and third lobes similar in shape to the median, but lacking an inner notch, progressively much smaller. Fourth lobe in a broad, sclerotized, conical or dentate process. Plate little fimbriate; two between the median lobes, two between the median and second, and three between the second and third all quite slender and spiniform; three between the third and fourth lobes and three laterally to the fourth broader, more or less conical, each produced apically into a linear elongation; prepygidial plates similar, the

anteriormost one at the posterolateral corner of the first abdominal segment. Gland tubercles: one to three prespiraculars, two to five anterior spiraculars, one to four mesothoracics, and one or two metathoracics; first abdominals absent. A marginal macroduct in each interlobar space (L 1–L 1; L 1–L 2; L 2–L 3), with the oral rim quite thickened; two between the third and fourth lobes and also between the fourth and the basal border of the pygidium; prepygidial marginal macroducts occurring anteriorly as far as the first abdominal segment, giving way to submarginal ventral macroducts scattered within the posterolateral corner of the metathorax and on the first abdominal segment. Submarginal dorsal macroducts scattered in a broad row extending anteriorly as far as the first or second abdominal segment, 21 to 44 in number on each side. A short row of submedian dorsal microducts on the basal border of the pygidium, and another row on the preceding segment. Many ventral microducts scattered in a transverse row between the posterior spiracle and the body margin. Anterior spiracle with six to 10 disc pores in a loose transverse row. Perivulvar pores absent or a single one present in the median group, 12 to 17 in the anterolateral, and 14 to 20 in the posterolateral; antero- and posterolateral groups tending to be joined on each side, practically confluent.

Specimens examined. Kuan-tzu-ling, on *Boehmeria densiflora*.

Distribution and host plants. This species was originally described from south Rhodesia as a feeder of *Fluggea microcarpa* and later recorded by Balachowsky from northern Africa on *Ficus carica* and *Xanthoxylon americanum*. So far as I am aware, there has been no authentic record of its occurrence outside Africa.

Remarks. *Parlatoria sexlobata* Takagi and Kawai and *Parlatoria octolobata* Takagi and Kawai, both originally described in *Parlatoreopsis*, are quite close to the present species. The similarity of *octolobata* to *fluggeae* is especially close, the differences between the two are rather slight as follows: in *fluggeae* the pygidial lobes are often notched several times or even serrate on the outer side, whereas in *octolobata* deeply once-notched; in *fluggeae* a short row of submedian dorsal microducts is present on the basal border of the pygidium (on the fifth abdominal segment) and another row on the preceding segment (on the fourth segment), whereas in *octolobata* such a row is present on each of the third to fifth abdominal segments. The two may rightly be separated, but a detailed comparison based on further material from various localities may be necessary to determine their exact relation.

IV. Genus ***Parlatoreopsis*** Lindinger

References. Lindinger *1912 b*: 191; Ferris *1942*: 404; McKenzie *1945*: 83; Balachowsky *1953 g*: 827.

Synonyms. *Anatolaspis* Bodenheimer, 1949 [type-species: *Anatolaspis abidini* Bodenheimer = *Chionaspis longispina* Newstead].

Type-species. *Chionaspis longispina* Newstead.

Diagnosis. Body oval in outline, with the pygidium triangular. Derm remaining membraneous except for the pygidium. Pygidial lobes well developed in two pairs, the third lobes slightly indicated or obsolete; median lobes prominent, set close, the second lobes much smaller than the median. Plates small and not fimbriate, sparse outside the third lobe (on the fifth and sixth abdominal segments). Prepygidial plates all reduced to tubercles; gland tubercles of the prosoma grouped as in *Parlatoria*. Marginal

macroducts with a thick, sclerotized rim around the orifice; one between the median lobes, enclosed within a pair of small, pyriform scleroses; one between the median and second, and also between the second and third (or the expected position of the third), each with the oral rim produced into a more or less prominent pyriform sclerosis on the inner side; those occurring outside the third lobe irregular and rather sparse in arrangement. Submarginal dorsal macroducts present or absent on the pygidium, scattered on the prepygidial abdomen. Submedian dorsal macroducts absent. Antenna with a seta. Anterior spiracle with a few disc pores. Anal opening towards the apex, or about the centre, of the pygidium. Perivulvar pores present.

Composition and distribution. This genus comprises four known species, all originated in the Old World: *longispina* (Newstead) occurs in eastern Mediterranean region to India, whereas *chinensis* (Marlatt), *pyri* (Marlatt) and *tsugae* Takagi and Kawai are presumably native to northeastern Asia. *Chinensis* was introduced to North America and established there. Furthermore, two other species *sexlobata* and *octolobata* were originally described in this genus, but should rightly be referred to *Parlatoria*.

Remarks. This genus is apparently very close to *Parlatoria*, from which it is separated usually by the pyriform scleroses associated with the marginal macroducts. These scleroses are quite prominent in the type-species and *longispina*, but less developed in *pyri* and *tsugae*, in the last species being reduced to mere swellings of the sclerotized oral rims. In the development of the oral rims there is a graded series through the species of the *cinerea*-group of *Parlatoria* and those of *Parlatoreopsis*, and the two genera can not sharply be distinguished on the basis of the presence or absence of the pyriform scleroses. The genus *Parlatoreopsis* may be better distinguished from *Parlatoria* by the reductive characters of the lobes and plates: all the species here referred to *Parlatoreopsis* have only two pairs of distinct lobes and much reduced plates.

13. ***Parlatoreopsis chinensis*** (Marlatt) [Fig. 6]

References. Marlatt *1908c*: 30 [*Parlatoria*]; Ferris *1942*: 405; McKenzie *1945*: 84; Balachowsky *1953g*: 832 [comparison with *longispina*].

Diagnosis. Median lobes set quite close, leaving a slender space between them, each with the inner margin straight and then divergent for a short length, curving round apically to a long, serrate, oblique outer margin, and with a slender linear sclerosis arising from near each basal angle. Second lobes similar to the median in shape, but much smaller. Third lobes practically obsolete. Marginal setae of the pygidium much elongate. Two plates between the median lobes, two between the median and second, and three between the second and the expected position of the third, the median and inner lateral pairs often hardly discernible. Gland tubercles few, the prespiracular and anterior spiracular groups each with one or two gland tubercles, the meso- and metathoracic each with two to four, the first to third abdominal segments with one to three and the fourth with one to four. Marginal macroducts situated between the median and second lobes and between the second lobe and the expected position of the third lobe each with the oral rim produced mesally into a prominent pyriform sclerosis. Two to four macroducts along the pygidial margin outside the expected position of the third lobe (on the fifth and sixth abdominal segments). Metathorax and free abdominal segments with macroducts irregularly scattered just within the

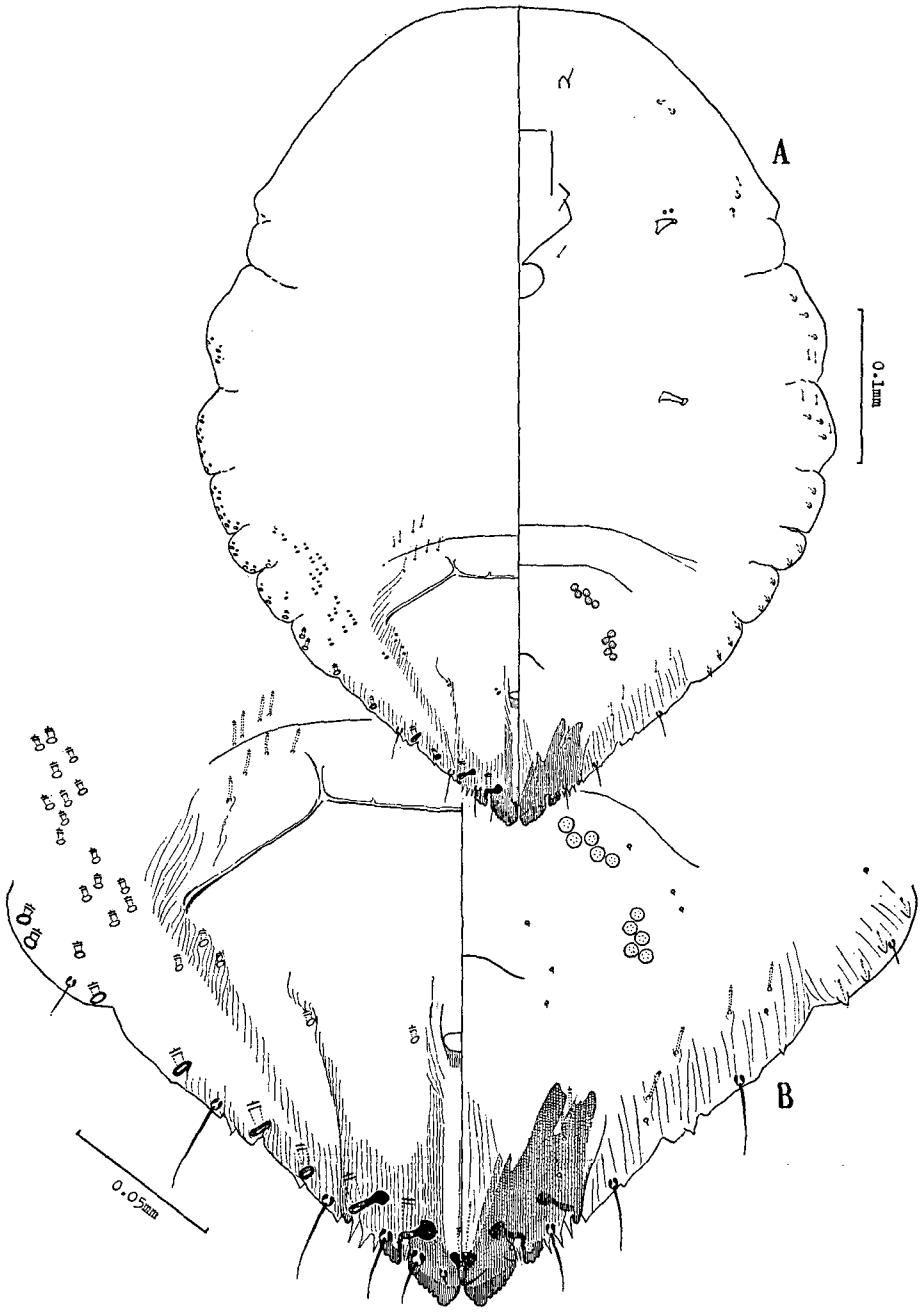

Fig. 6. *Parlatoreopsis chinensis* (Marl.). Adult female (A, body ; B, pygidium).

margin. Anal opening towards the centre of the pygidium, with a small dorsal duct on each side; similar submarginal ducts in a narrow row from the basal corner of the pygidium onto the second abdominal segment. Prosomatic tubercle in a low, broad, rounded, membraneous prominence opposite the anterior spiracle. Anterior spiracle with one to three disc pores. Perivulvar pores absent in the median group, five to seven in the anterolateral, and three to five in the posterolateral.

Specimens examined. Heng-chun, on *Hibiscus tiliaceus* [some specimens all in poor condition].

Distribution and host plants. This species occurs in China and Japan, and was introduced into North America. It has been recorded from various plants such as "crab-apple", *Hibiscus*, *Xanthoxylon*, *Thuja orientalis*, jujube, "flowering cherry" and *Eriobotrya japonica*. So far as I am aware, this species has hitherto been not recorded from Taiwan.

V. Genus ***Neoparlatoria*** Takahashi

References. Takahashi *1931 b*: 381.

Type-species. *Neoparlatoria formosana* Takahashi.

Diagnosis. Pupillarial, the adult female remaining within the second exuvium. Pygidium produced, of the shape of a triangular. Derm membraneous except for the pygidium, which is weakly sclerotized. Pygidial lobes in two or three pairs, all similar in shape, asymmetrical, small yet rather prominent, and well sclerotized. Plates simple in shape, more or less exceeding the lobes in length, always present between the median lobes. A number of gland tubercles scattered just within the margin on the thorax and the base of the abdomen, forming a continuous or interrupted row on each side. Dorsal macroducts, if present, scattered along the pygidial margin; always absent between the median lobes. Marginal setae of the pygidium remarkably elongate. Antenna with a seta. Anterior spiracle with or without disc pores, which are, if present, quite few. Anal opening rounded, situated about the centre of the pygidium or rather towards the apex of the pygidium. Perivulvar pores present.

Second exuvium of the female enlarged, oblong, with three or four pairs of lobes, well-fimbriate plates and marginal macroducts on the pygidium. Lobes well developed, all similar in shape; in *formosana* the median lobes separated from each other by a good space, which is occupied by a pair of plates, and each lobe with a pair of slender basal scleroses converging anteriorly. Plates not exceeding the lobes in length.

Composition and distribution. The type-species was originally described from Taiwan and later recorded from Japan. Two other species, *lithocarpi* Takahashi and *lithocarpicola* Takahashi were also described from Taiwan, and *lithocarpicola* was later recorded from Thailand. In the present study two new species are added to the genus. Certain Indian species (*Parlatoria vateriae* Green; *Cryptoparlatorea pini* Takahashi) appear to be close to the members of the genus.

Remarks. This genus has main characters in common with *Parlatoria* in the second instar female, but is distinguished by some reduced or modified characters of the imprisoned adult female. This genus is very close to *Cryptoparlatorea*, another pupillarial genus of the Parlatorini from Japan, but in the latter the pygidial lobes are quite reduced in size and a marginal macroduct is present between the median lobes. The second exuvium of the female of *Cryptoparlatorea* is peculiar in shape, being

constricted laterally. It may be better to distinguish the two genera until detailed comparative studies have been made on further forms of pupillarial parlatorines.

14. ***Neoparlatoria maai***, n. sp. [Fig. 7]

Diagnosis. Body oblong. Granulations of the derm just posteriorly to the mouth-parts. Pygidial lobes in three pairs all practically same in shape and size, serrate on the oblique outer margin. Plates slender, much exceeding the lobes in length, each ended apically in a linear elongation; two between the median lobes, two between the median and second, three between the second and third, and about 10 laterally to the third (on the fifth and sixth abdominal segments). Eight or nine gland tubercles on the thorax opposite the posterior spiracle, and about 40 to 50 on the base of the abdomen (on the supposed first and second segments). Dorsal macroducts absent. A number of microducts scattered in five transverse bands on the prepygidial ventrum, the anteriormost of these bands running just posteriorly to the mouth-parts; some microducts strewn just laterally to the mouth-parts. Anterior spiracle with a disc pore. Anal opening towards the centre of the pygidium. Perivulvar pores absent in the median group, 12 to 14 in the anterolateral and 16 or 17 in the posterolateral, the antero- and posterolateral groups almost confluent on each side.

Second exuvium of the female with the median to third lobes well developed, all same in shape and size, being serrate on the oblique outer margin, the median lobes set close together; fourth lobes similar but smaller, pointed apically; fifth lobes much reduced. Plates not discernible between the median lobes; two between the median and second lobes, three between the second and third; three between the third and fourth lobes and three laterally to the fourth somewhat broader. A marginal macroduct between the median and second lobes and also between the second and third, two between the third and fourth and also laterally to the fourth. Anal opening towards the centre of the pygidium.

Specimens examined. A-li Shan, on the leaf of *Castanopsis* sp. [one adult female with its second exuvium].

Remarks. This species is distinguishable from all the other species of the genus by lacking dorsal macroducts in the adult female.

15. ***Neoparlatoria miyamotoi***, n. sp. [Fig. 8]

Diagnosis. Body broadest across the base of the abdomen, thence abruptly narrowed posteriorly. Granulations of the derm just posteriorly to the mouth-parts. Pygidial lobes in two pairs, conical, often variously incised or serrate; second lobes smaller than the median. Plates not much exceeding the lobes in length, two between the median lobes, two between the median and second, and three laterally to the second. Gland tubercles numerous (about 50 on each side), forming a continuous row along the margin on the thorax and the base of the abdomen. Dorsal macroducts small, one present or absent between the median and second lobes, and one to four scattered laterally to the second. Many microducts strewn on the prepygidial ventrum. Anterior spiracle without disc pores, or occasionally with a single pore. Anal opening rather towards the apex of the pygidium. Perivulvar pores absent in the median group, the antero- and posterolateral groups often confluent on each side, containing nine to 11 disc pores in all.

Second exuvium of the female with the pygidium demarked from the remainder of

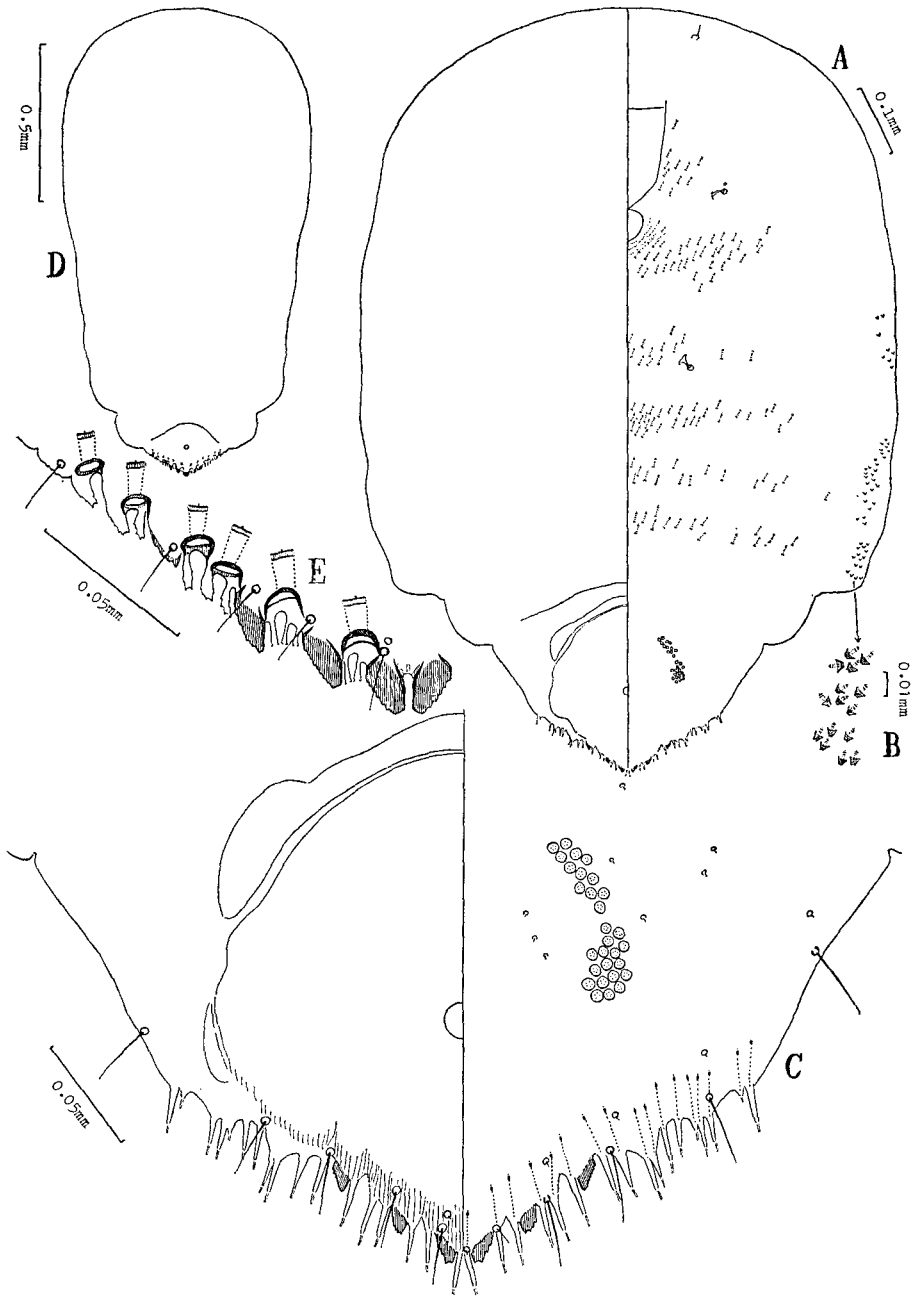

Fig. 7. *Neoparlatoria maai*, n. sp. A-C, adult female (A, body; B, gland tubercles; C, pygidium); D & E, exuvium of the second instar female (D, body; E, margin of the pygidium).

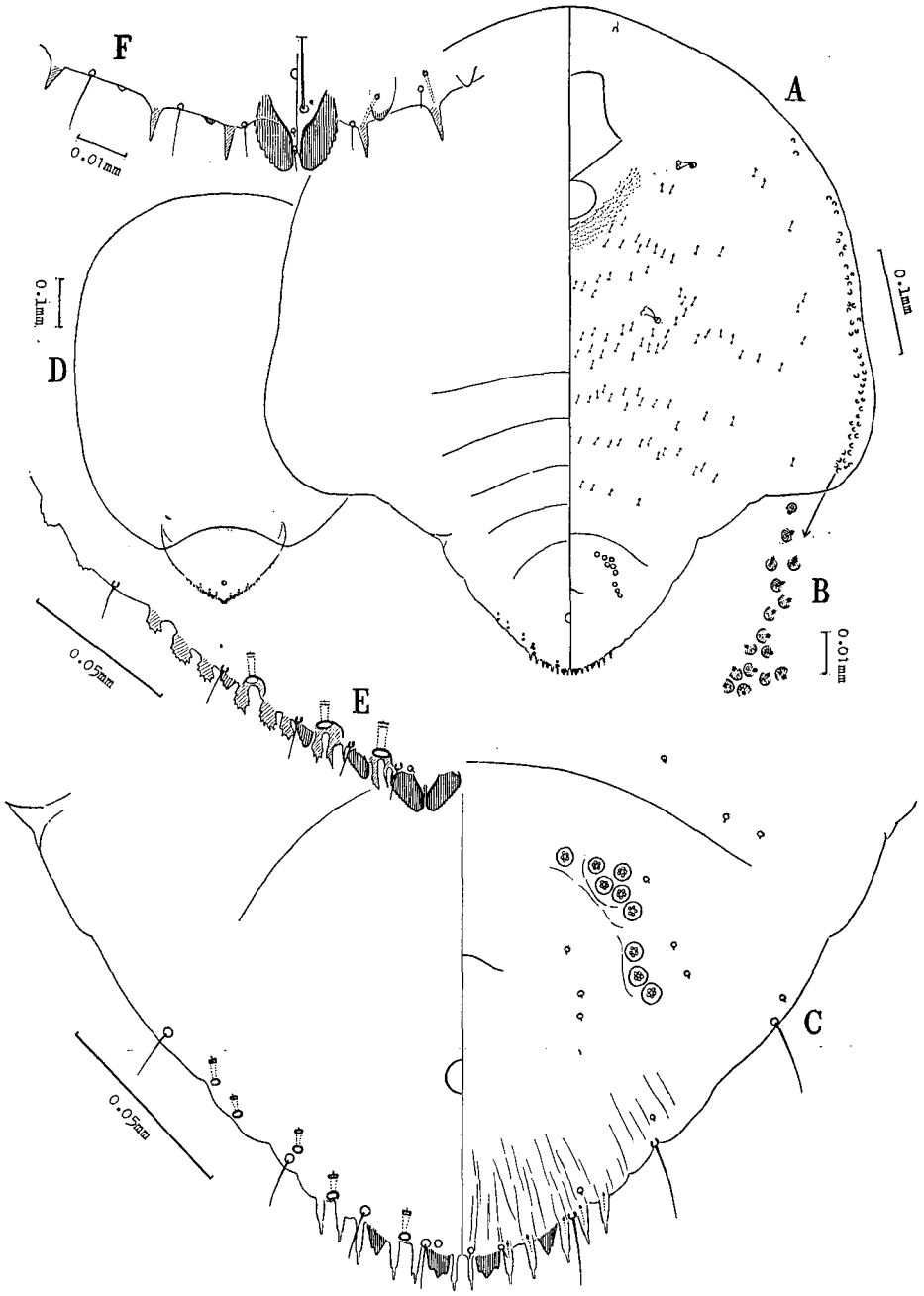

Fig. 8. *Neoparlatoria miyamotoi*, n. sp. A–C, adult female (A, body; B, gland tubercles; C, pygidium); D & E, exuvium of the second instar female (D, body; E, margin of the pygidium); F, exuvium of the first instar larva (posterior extremity of the body).

the body by a transverse sclerotized fold. Median lobes set quite close, leaving a slender space between them, convergent, with the outer margin finely serrate; second and third lobes similar in shape, but much smaller. Fourth lobe replaced by a small process. Plates indiscernible between the median lobes, two between the median and second, three between the second and third, innermost of them much smaller, three between the third and fourth broader, and three laterally to the fourth similar but tending to be shorter. A marginal macroduct between the median and second lobes, between the second and third, and also just mesally to the fourth. Anal opening towards the apex of the pygidium.

Specimens examined. Fen-chi-hu, on the leaves of *Castanopsis kusanoi*.

Remarks. This species has two pairs of pygidial lobes in the adult female like *lithocarpicola*, from which it is easily distinguishable by the pygidial lobes smaller, the plates not furcate apically, and the perivulvar pores more numerous. It is distinguishable from the other species of the genus by lacking the third lobes in the adult female.

VI. Genus ***Silvestraspis*** Bellio

References. Bellio *1929*: 159.

Type-species. *Silvestraspis sinensis* Bellio=*Cryptoparlatorea uberifera* Lindinger.

Diagnosis. Pupillarial. Body broad and rather rhombic in outline, with an enormous, elongate thoracic process produced lateroposteriorly on each side. Derm membraneous, slightly sclerotized on the pygidium. Pygidium with three pairs of lobes all small and sclerotized; median lobes well separated from each other. Plates well developed on the pygidium, surpassing the lobes, and cylindrical in shape. Gland tubercles present on the thorax. Macroducts absent. Antenna with a seta. Anal opening at the centre of the pygidium. Perivulvar pores not numerous.

Composition and distribution. This genus is represented only by the type-species, which is widely distributed in southeastern Asia.

Remarks. This genus is unique by the body shape and the cylindrical plates. In some respects, however, it resembles *Neoparlatoria* and *Cryptoparlatorea*, and may belong to this eastern Asiatic stock of pupillarial parlatorines.

16. ***Silvestraspis uberifera*** (Lindinger) [Fig. 9]

References. Lindinger *1911*: 126 [*Cryptoparlatorea*]; Bellio *1929*: 160 [*sinensis*]; Ferris *1941a*: 20 [illustration].

Synonyms. *Silvestraspis sinensis* Bellio, 1929.

Diagnosis. Median lobes pointed apically, notched subapically on either side; second lobes similar to the median, the third tending to be reduced. Plates a little swollen apically, two between the median lobes, two between the median and second, three between the second and third, and four laterally to the third. Two or three gland tubercles laterally to the anterior spiracle, and about 15 in a row on the whole length of the thoracic process. Anterior spiracle with a disc pore. Perivulvar pores absent in the median group, six in the anterolateral and four in the posterolateral.

Specimens examined. Ken-ting, on *Machilus kusanoi* [one adult female in poor condition].

Distribution and host plants. This species was originally described from specimens collected in Celebes on *Artocarpus* sp. and in the Philippines on *Mallotus philippinensis*.

Bellio described it under the name *sinensis* on the basis of specimens collected in China on an undetermined plant. Takahashi recorded it in Taiwan on *Cinnamomum zeylanicum* and also in Cambodia. Specimens collected in Kowloon Peninsula, Hongkong, on *Zyzygium jambos* are also at hand.

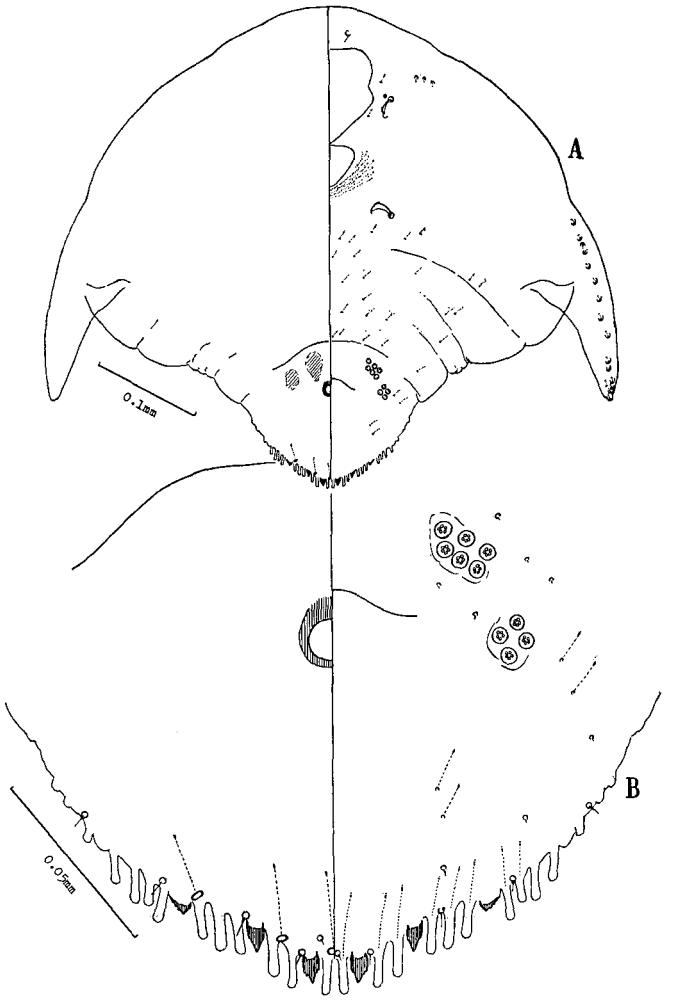

Fig. 9. *Silvestraspis uberifera* (Lindgr.). Adult female (A, body; B, pygidium).

VII. Genus ***Mixaspis*** Takahashi

References. Takahashi *1932*: 46.

Type-species. *Leucaspis bambusicola* Takahashi.

Diagnosis. Pupillarial. Body much elongate, with the pygidium rounded. Pygidial lobes in three pairs, comparatively small in size, each with a pair of slender basal

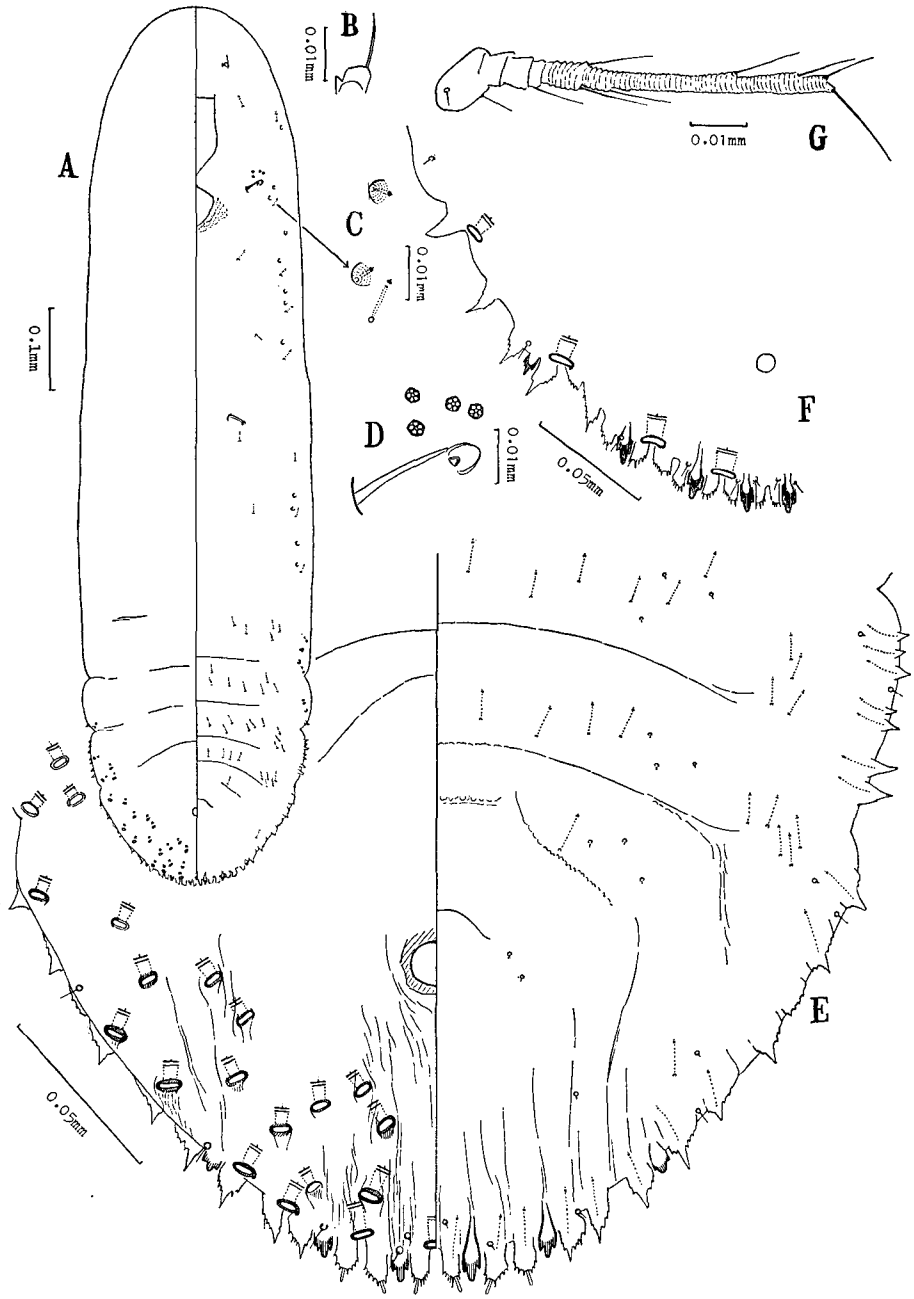

Fig. 10. *Mixaspis bambusicola* (Takah.). A–E, adult female (A, body; B, antenna; C, gland tubercles; D, anterior spiracle; E, pygidium); F, exuvium of the second instar female (pygidium); G, exuvium of the first instar larva (antenna).

scleroses converging anteriorly; median lobes widely separated from each other, with a pair of plates between them; third lobes reduced in size. Plates short and broad, those occurring around the apex of the pygidium are well fimbriate, but those laterally to the third lobe tending to be reduced, giving way to gland tubercles on the basal three abdominal segments and cephalothorax, the prosomatic gland tubercles arranged in groups as in *Parlatoria*. Dorsal macroducts short and broad, with a thickly sclerotized rim around the orifice. Antenna with a single seta. Anterior spiracles with disc pores. Anal opening rather towards the base of the pygidium. Perivulvar pores absent.

Second exuvium of the female enlarged, similar to the adult female in shape and in the pygidial fringe. Pygidial lobes in three pairs well developed, fourth lobes reduced, yet sclerotized.

Composition and distribution. This genus was erected for a single species occurring on bamboo in Taiwan and accepted by Ferris as probably valid. No further information has been given of the composition and distribution of the genus.

Remarks. This genus differs from the authentic genera of the Parlatorini, both pupillarial and non-pupillarial, by the much elongate body-shape, and was referred to his Leucaspidina by Balachowsky. However, I am much inclined to the opinion that this genus is a parlatorine, having unisetose antennae, glanduliferous plates and some other characters.

17. ***Mixaspis bambusicola*** (Takahashi) [Fig. 10]

References. Takahashi *1930*: 26 [*Leucaspis*]; Ferris *1937 d*: 113 [illustration].

Diagnosis. Body about four times as long as wide, the lateral sides almost straight and parallel, the third and fourth abdominal segments weakly lobed out laterally. Derm membraneous except for the pygidium, which is weakly sclerotized on the pygidium. Median lobes deeply incised once on each side, the second similar to the median, the third more or less reduced in size, sometimes modified into a serrate process. Plates well developed on the pygidium, two between the median lobes, two between the median and second and three between the second and third all fimbriate; five or six plates laterally to the third lobe broader, quickly narrowing towards the apex and tending to be less fimbriate. Four to seven plates on the fourth abdominal segment and one at the posterolateral corner of the third segment conical and not fimbriate. One prespiracular gland tubercle, two to five anterior spiraculars, five to eight mesothoracics, two or three metathoracics, two first abdominals, two second abdominals, and one to four third abdominals, a few microducts associated with each of these groups of gland tubercles. A marginal macroduct between the median lobes, one between the median and second, one or two between the second and third, and some laterally to the third as far as the third abdominal segment. Seven to 11 submarginal macroducts scattered on each side of the pygidium and one or two in the posterolateral corner of the fourth abdominal segment. Anterior spiracle with three or four disc pores in a loose cluster.

Specimens examined. Yang-ming Shan, on bamboo.

Distribution and host plants. This species was originally described from specimens collected in Taiwan on bamboo and no further record of this species has hitherto been made.

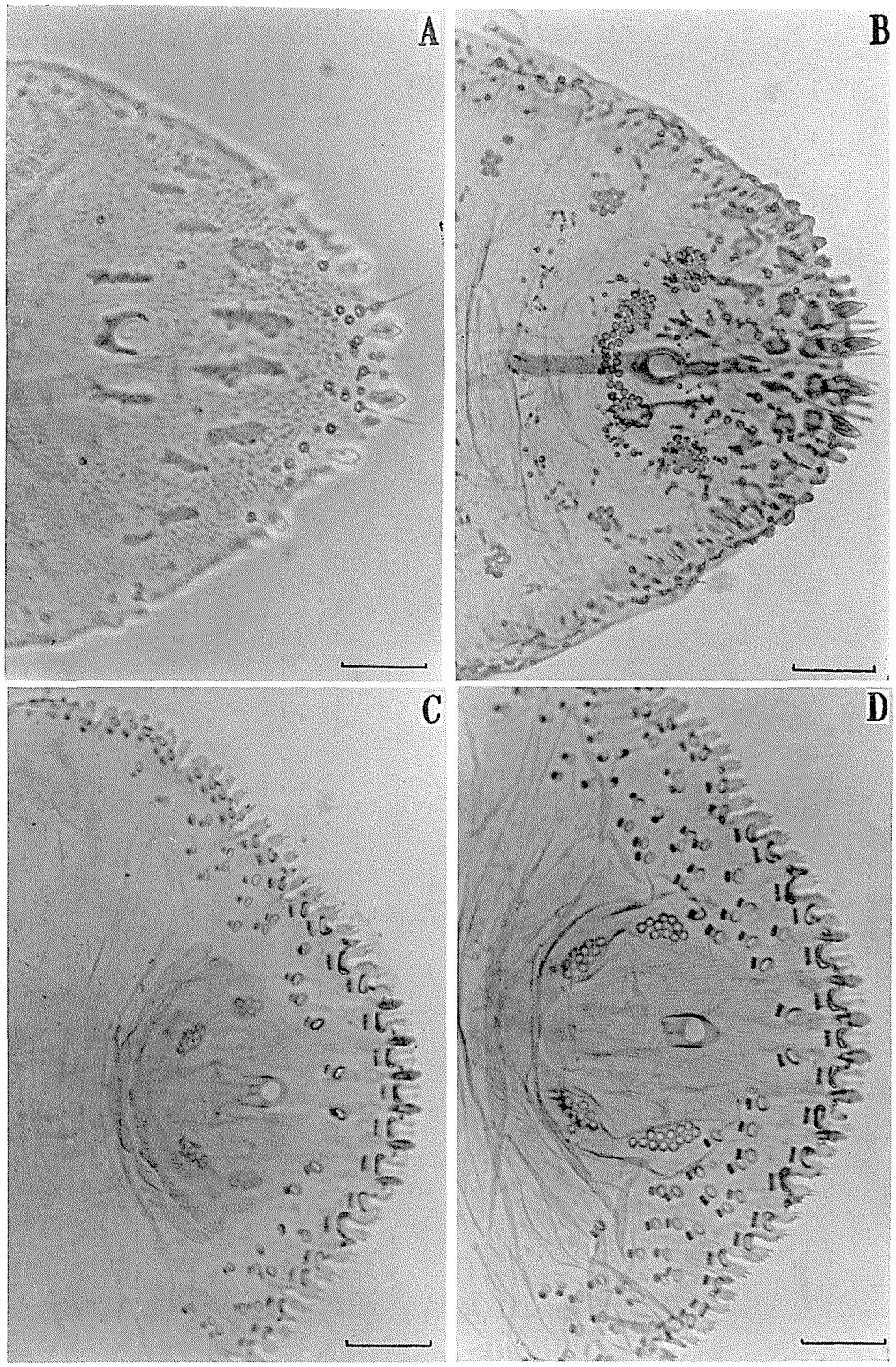

Fig. 11. A–D, adult females (pygidium). A, *Leucaspis incisa*, n. sp.; B, *Lopholeucaspis japonica* (Cockll.); C, *Parlatoria camelliae* Comst. ; D, *Parlatoria theae* Cockll. ——: 0.05 mm.

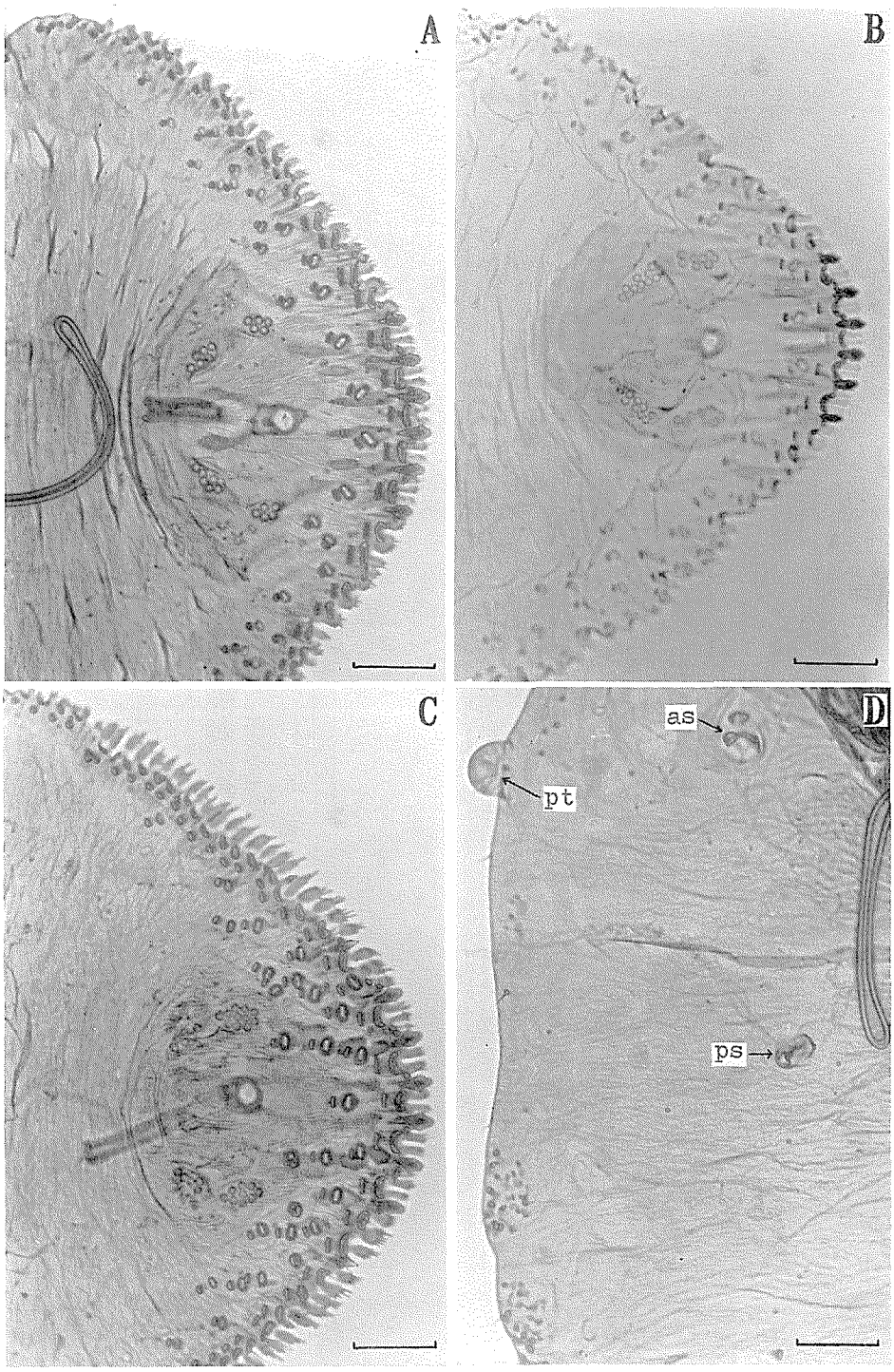

Fig. 12. A–D, adult females (A–C, pygidium; D, part of the body). A, *Parlatoria proteus* (Curt.); B, *Parlatoria arengae*, n. sp.; C & D, *Parlatoria ziziphi* (Luc.) (pt, prothoracic tubercle; as, anterior spiracle; ps, posterior spiracle).

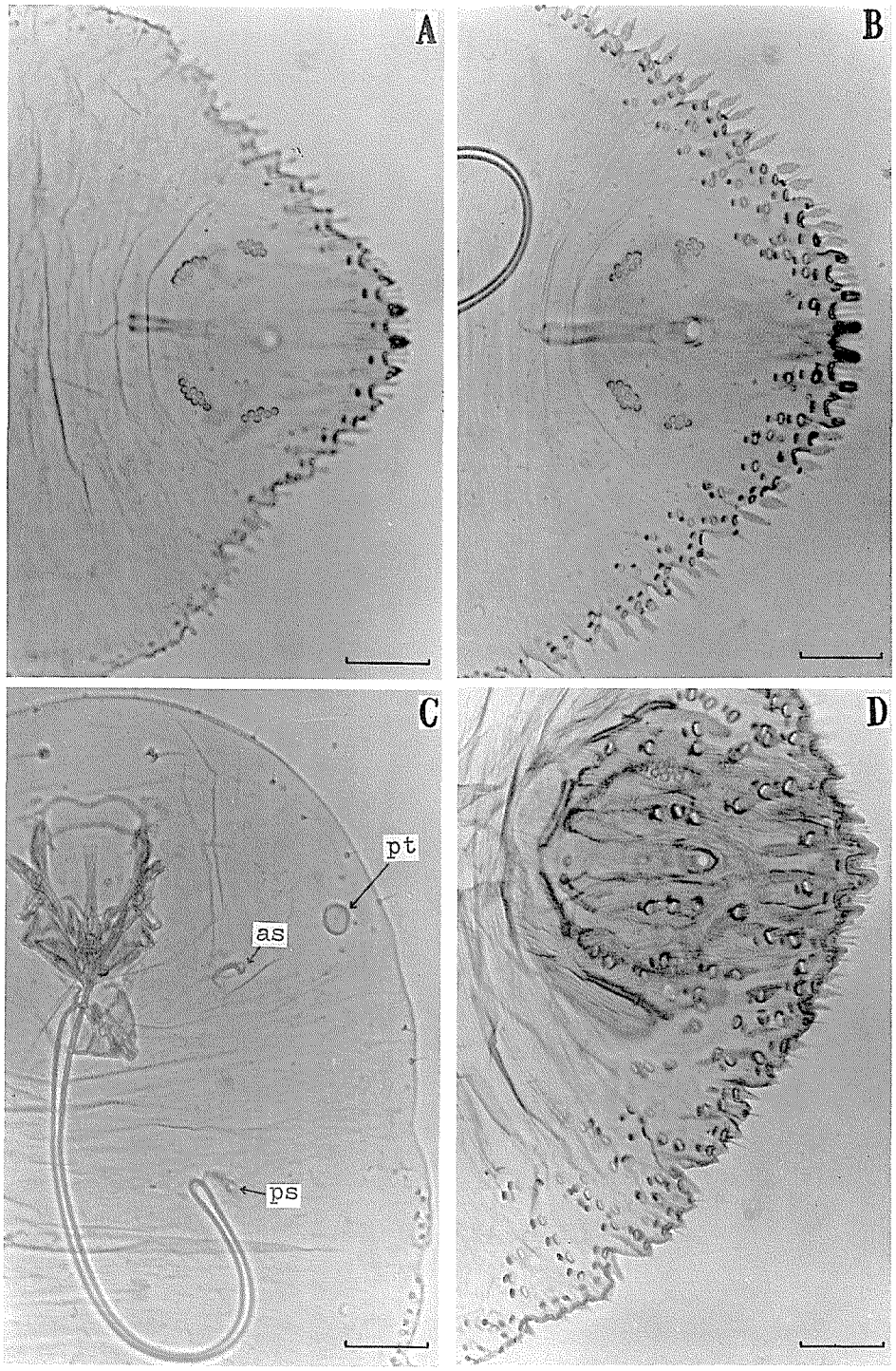

Fig. 13. A–D, adult females (A, B & D, pygidium ; C, part of the body). A, *Parlatoria machili* Takah. ; B & C, *Parlatoria machilicola* Takah. (pt, prothoracic tubercle ; as, anterior spiracle; ps, posterior spiracle) ; D, *Parlatoria cinerea* Had.

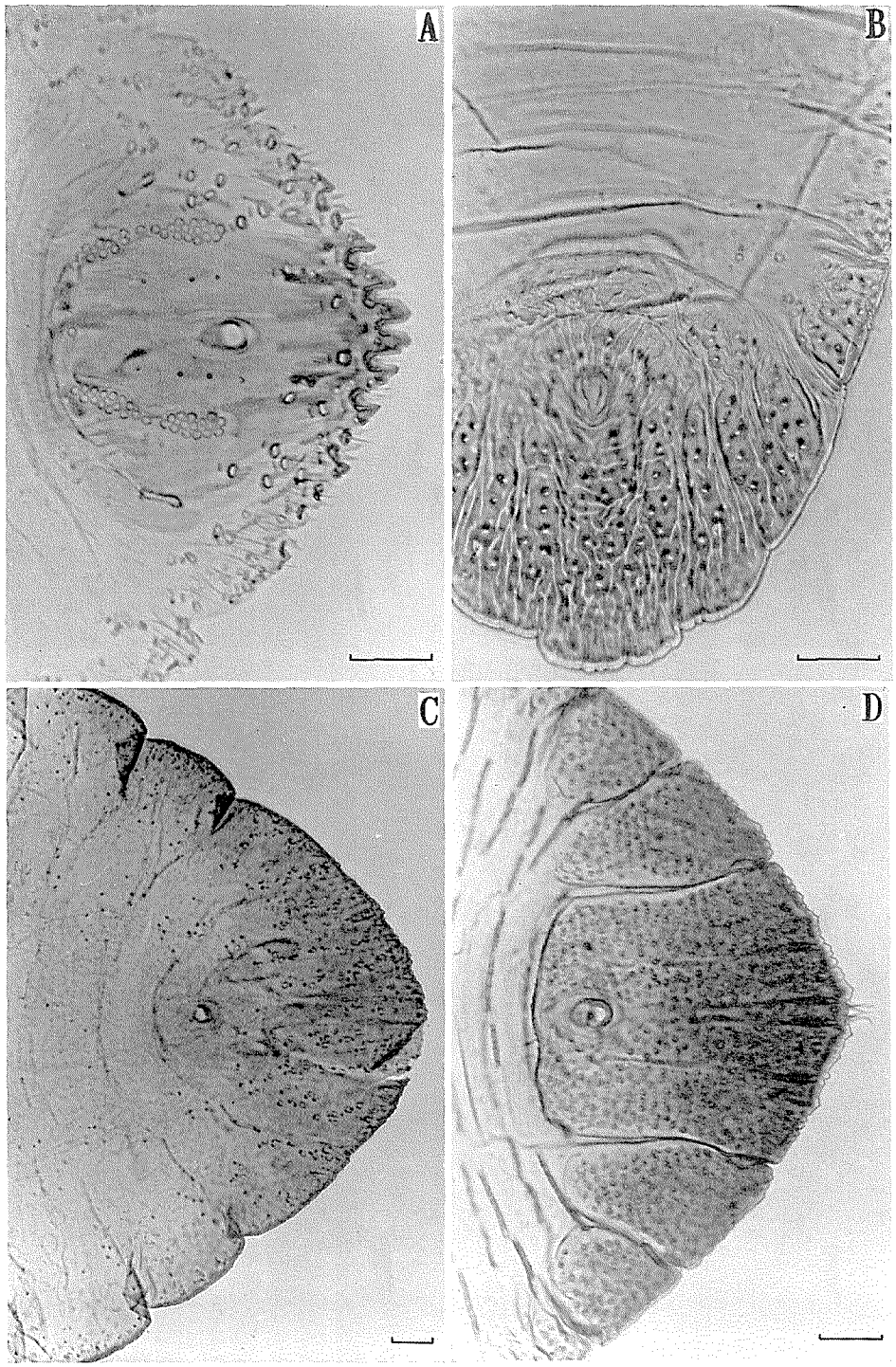

Fig. 14. A–D, adult females (pygidium). A, *Parlatoria fluggeae* Hall; B, *Smilacicola apicalis*, n. sp.; C, *Poliaspoides formosanus* (Takah.);D, *Odonaspis penicillata* Gr.

Tribe **Rugaspidiotini**

VIII. Genus ***Smilacicola***, n. g.

Type-species. *Smilacicola apicalis*, n. sp.

Diagnosis. Body elongate-pyriform, being swollen and rounded in the cephalothorax; free abdominal segments little lobed laterally. Derm strongly sclerotized on the pygidium and the lateral area of posterior prepygidial segments. Pygidium produced apically into a broad protuberance, lacking marginal processes. Marginal scleroses absent on the pygidium. Ducts numerous, strewn on the pygidium and the prepygidial abdominal segments; these ducts are small in size, but in the type-species the dorsal ducts are distinctly larger than the ventral on the pygidium. Antennae with many setae. Anterior spiracles with disc pores; posterior spiracles also with disc pores in the type-species. Anal opening near the base of the pygidium. Perivulvar pores absent.

Composition and distribution. The type-species occurs in Taiwan. Another species, which is undoubtedly referable to this genus, is at hand from Hongkong. *Rugaspidiotus heimi* Balachowsky, which was described from Vietnam, is here transferred to this genus.

Remarks. The three species referred here to this new genus all well agree in the external characters of the adult females. The host plants of the two species from Taiwan and Hongkong are liliaceous lianoid plants of the genus *Smilax*; the host of *heimi* is an undetermined lianoid plant ("une liane ampelidée indéterminée"), which may possibly be a *Smilax*-species. I am very much inclined to the opinion that this genus is a good group in southeastern Asia, possibly associating exclusively with *Smilax*.

This genus may be distinguishable from the other genera of the tribe by the combination of the following characters: the elongate-pyriform body; the multisetose antennae; the larger dorsal and smaller ventral ducts of the pygidium; the close situation of the anal opening to the base of the pygidium; and the absence of perivulvar pores. It should be also noted that the first instar larva of the type-species has six-segmented antennae.

18. ***Smilacicola apicalis***, n. sp. [Fig. 14 B; 15; 16]

Diagnosis. Pygidium roughly of the shape of a trapezoid in outline, with the margin slightly and sparsely notched around, and with the apical protuberance broad, extending laterally beyond the apicalmost marginal setae. Whole pygidium and the lateral area of the preceding segment thickly strewn with larger ducts (macroducts) on the dorsal surface and with much smaller ducts (microducts) on the ventral surface; the other prepygidial segments of the abdomen with many macroducts on the lateral area of the ventral surface, and with much less numerous macroducts confined within the marginal area of the dorsal surface. Submedian microducts strewn on the ventrum on the prepygidial abdominal segments. Marginal and submarginal setae of the pygidium somewhat enlarged and spine-like on both surfaces. Antennae widely separated from each other, each with six setae, of which two are much smaller than the other. Anterior spiracle with a loose cluster of 10 to 26 disc pores; posterior spiracle with a smaller cluster of five to 11 disc pores.

Specimens examined. Ken-ting, on *Smilax* sp., under the stipules.

Remarks. This species is easily distinguishable from *heimi* by the antennae with

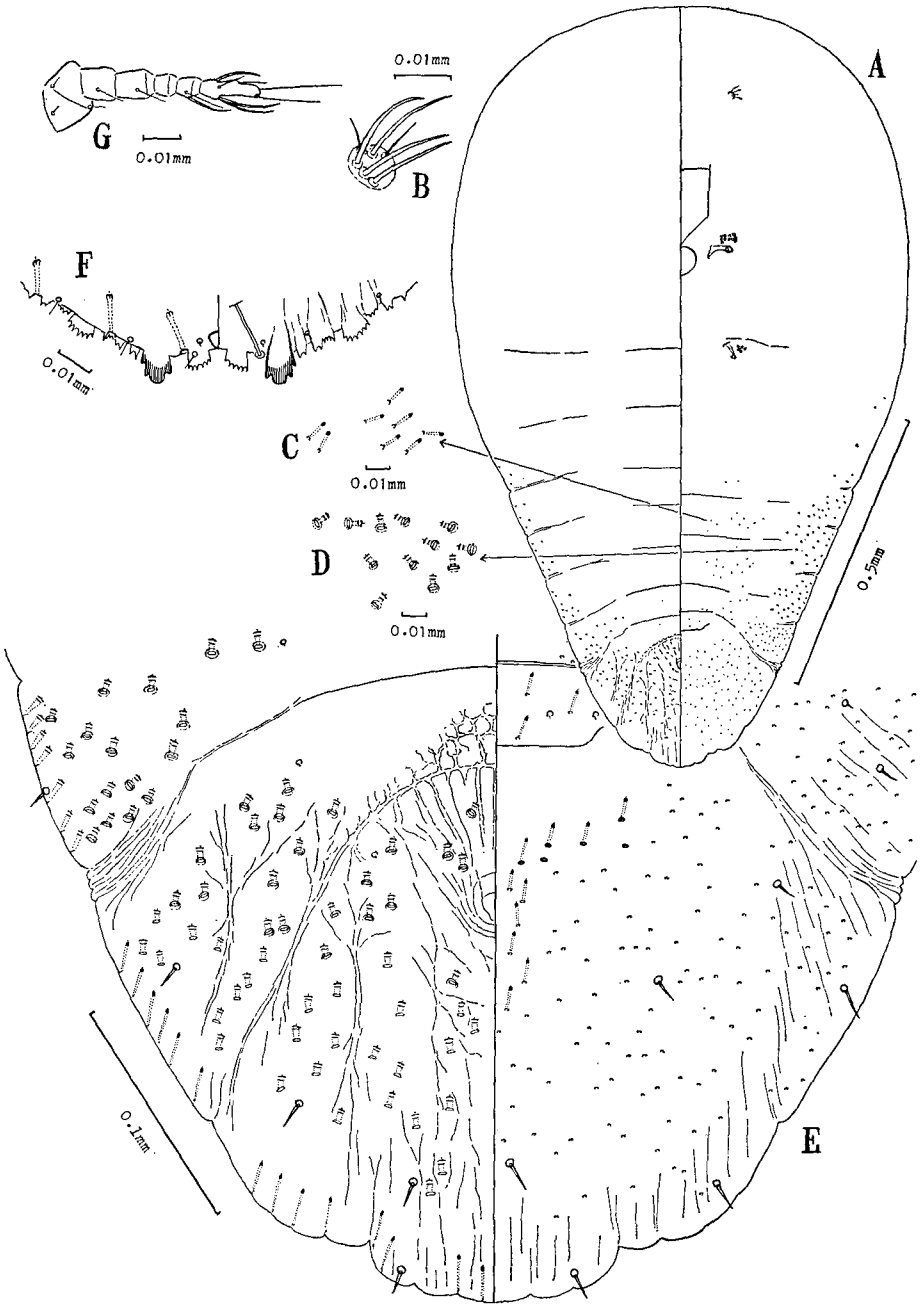

Fig. 15. *Smilacicola apicalis*, n. sp. A–E, adult female (A, body; B, antenna; C, submedian ducts of the prepygidial abdominal region; D, submarginal ducts of the prepygidial abdominal region; E, pygidium); F & G, exuvium of the first instar larva (F, posterior extremity of the body; G, antenna).

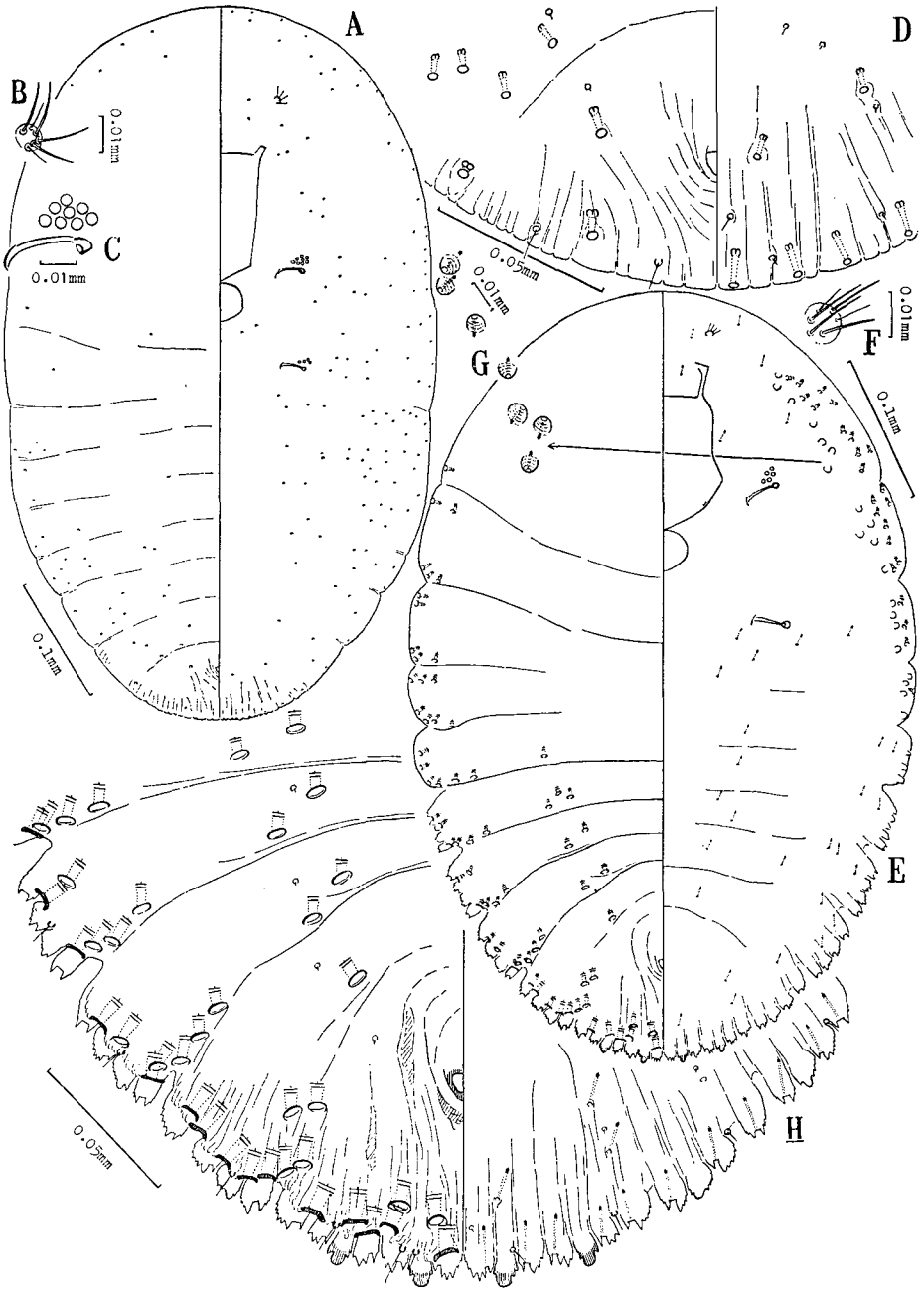

Fig. 16. *Smilacicola apicalis*, n. sp. A–D, second instar female (A, body; B, antenna; C, anterior spiracle; D, pygidium); E–H, second instar male (E, body; F, antenna; G, gland tubercles; H, pygidium).

less numerous setae, the spiracular disc pores less numerous, the apical protuberance of the pygidium broader, the ventral ducts of the pygidium all minute, etc.

IX. Genus ***Poliaspoides*** MacGillivray

References. MacGillivray *1921*: 309; Ferris *1937 a*: 34 and 40, and *1938 b*: 71 and 74 [illustrations of the type-species of *Poliaspoides* and *Natalaspis* with discussion on nomenclature]; Goux *1937*: 41.

Synonyms. *Natalaspis* MacGillivray, 1921 [type-species: *Chionaspis simplex*: Brain, nec Green].

Type-species. *Chionaspis simplex* Green.

Diagnosis. Body elongate, with the free segments quite gently lobed laterally. Derm sclerotized on the pygidium and the lateral area of the prepygidial segments of the abdomen. Pygidium slightly roundish, the margin crenulate and more or less rugged with slight, irregular prominences, otherwise with nothing particular. Marginal scleroses absent. Ducts practically strewn on both surfaces, all small, but the dorsal ducts distinctly larger than the ventral on the pygidium. Antenna small, with two short setae. Anterior spiracles with disc pores not numerous. Anal opening small, close to the base of the pygidium. Perivulvar pores in five or seven groups, the supplementary groups being situated medioposteriorly to the usual posterolateral groups.

Composition and distribution. This genus was established to accept *Chionaspis simplex* Green, which was originally described from Ceylon and later recorded from India. *Natalaspis* was proposed simultaneously for an unnamed form close to *simplex* ("*Chionaspis simplex*, var.") described by Brain (*1920*) from Natal. Green (*1899 a*) described a form of *simplex* from Mauritius, and this form may be identical with Brain's form from Natal. *Odonaspis simplex* var. *formosana* Takahashi was described from Taiwan. Mamet (*1946*; *1949*) supposed *formosana* to be identical with the forms described by Green and Brain from Mauritius and Natal, but I have some doubt about this identity. *Massiliensis* Goux was described from France.

Remarks. This genus is similar in some respects to *Rugaspidiotus* MacGillivray and was included within the latter by Balachowsky (*1953 g*). So far as the type-species are concerned, however, it seems that the two are distinct, *Poliaspoides* differing from *Rugaspidiotus* by the dorsal ducts distinctly larger than the ventral ducts on the pygidium, by the anal opening close to the base of the pygidium and by the perivulvar pores present. This genus is quite close to *Rugaspidiotinus* Balachowsky, from which it differs by the fewer antennal setae and the presence of perivulvar pores. As here understood this genus is a biological rather than morphological unit, being composed of graminivorous species occurring in the Old World.

19. ***Poliaspoides formosanus*** (Takahashi) [Fig. 14 C; 17]

References. Takahashi *1930*: 29 [*Odonaspis simplex* var.].

Diagnosis. Body elongate-oval. Dorsal ducts numerous on the pygidium; tending to be arranged in segmental and intrasegmental rows in both submedian and submarginal regions on the preceding three segments (on the third to fifth abdominal segments). Ventral ducts quite numerous on the pygidium and the lateral lobes of the prepygidial segments as far as the mesothorax; scattered also in the submedian region on the second to fifth abdominal segments, between the body margin and the posterior spiracle, and in the cephaloprothoracic region. Anterior spiracles situated posteriorly to the

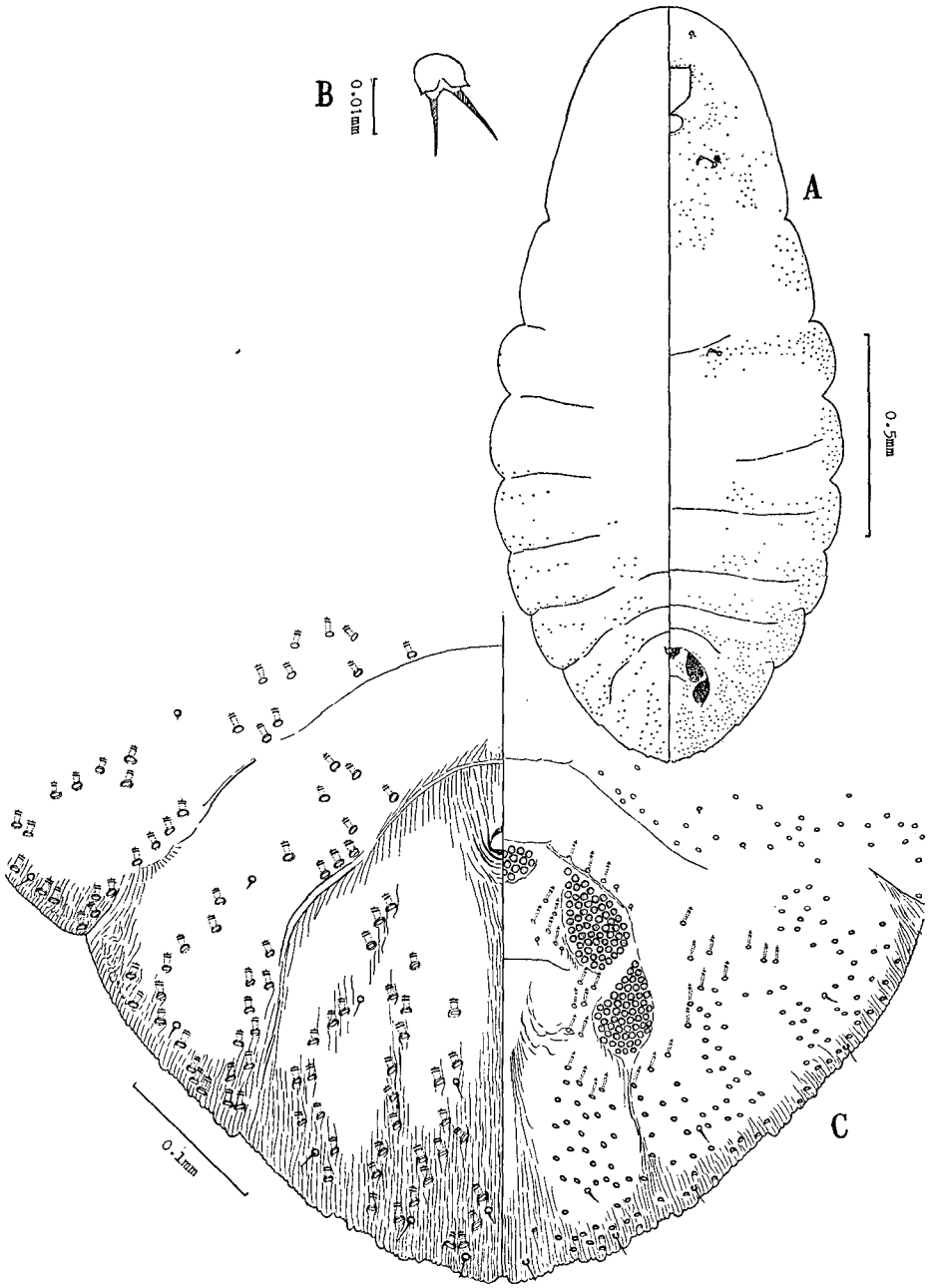

Fig. 17. *Poliaspoides formosanus* (Takah.). Adult female (A, body; B, antenna; C, pygidium).

mouth-parts, each with five to eight disc pores. Perivulvar pores small in size, numerous in five groups.

Specimens examined. Yang-ming Shan, on bamboo [two adult females].

Distribution and host plants. This species was described from specimens collected in Taiwan on various bamboos.

Remarks. This species is quite close to *Poliaspoides simplex* (Green), from which it may be distinguishable by the pygidial ducts evidently more numerous. Judging from Ferris' studies (l. c.) this species appears to be distinct from Brain's form of *simplex* from Natal, the type-species of *Natalaspis*. The latter may actually be a mere variant of *simplex*.

Tribe **Odonaspidini**

X. Genus ***Odonaspis*** Leonardi

References. Leonardi *1897*: 284; Ferris *1938a*: 161; Balachowsky *1953g*: 729; ibid. *1958b*: 299.

Synonyms. *Dycryptaspis* Leonardi, 1897 [type-species: *Aspidiotus secretus* Cockerell]; *Spatheaspis* Leonardi, 1898 [type-species: *Aspidiotus secretus* Cockerell]; *Froggattiella* Leonardi, 1900 [type-species: *Aspidiotus inusitatus* Green]; *Anoplaspis* Leonardi, 1900, nec 1898 [type-species: *Aspidiotus bambusarum* Cockerell]; *Berlesaspidiotus* MacGillivray, 1921 [type-species: *Aspidiotus bambusarum* Cockerell]; *Bakeraspis* MacGillivray, 1921 [type-species: *Odonaspis schizostachyi* Cockerell and Robinson].

Type-species. *Aspidiotus secretus* Cockerell.

Diagnosis. Body oval or nearly so. Segmentation distinct, the postsomatic intersegmental lines being sclerotized in comb-like rows of spicules for a broad median region; derm sclerotized on the pygidium and more or less so on the lateral area of the prepygidial abdominal segments and even thorax. Pygidium crenulate marginally. In the type-species the median lobes fused together completely; in others the fused median lobes are less prominent or even obsolete; in a certain species (*penicillata*) the apex of the pygidium is occupied by glanduliferous spiniform processes. Marginal scleroses present on the pygidium, in some species in four pairs, but in others the outer two or three pairs lacking. In some species gland tubercles present on the pro- and mesothorax. Ducts small, all of one type in both size and shape, strewn on the pygidium and the prepygidial lateral area on both dorsal and ventral surfaces. Antenna with a seta. Anterior spiracles with disc pores; posterior spiracles with or without disc pores. Anal opening small, towards the base of the pygidium. Perivulvar pores present or absent, if present numerous, forming a practically continuous arch or two lateral groups.

Composition and distribution. This genus is composed of graminivorous species from various parts of the world, but most of these species are presumably native to southeastern Asia and North America.

Remarks. The presence or absence of the fused median lobes, the presence or absence of perivulvar pores, the presence or absence of spiniform processes at the apex of the pygidium, all these characters are not employed here in the generic forming, but an emphasis is laid upon the similarity in the shape, size and distribution of the ducts. In the composition here adopted the members of the genus are somewhat diverse, but are included for a while within the same genus on account of their

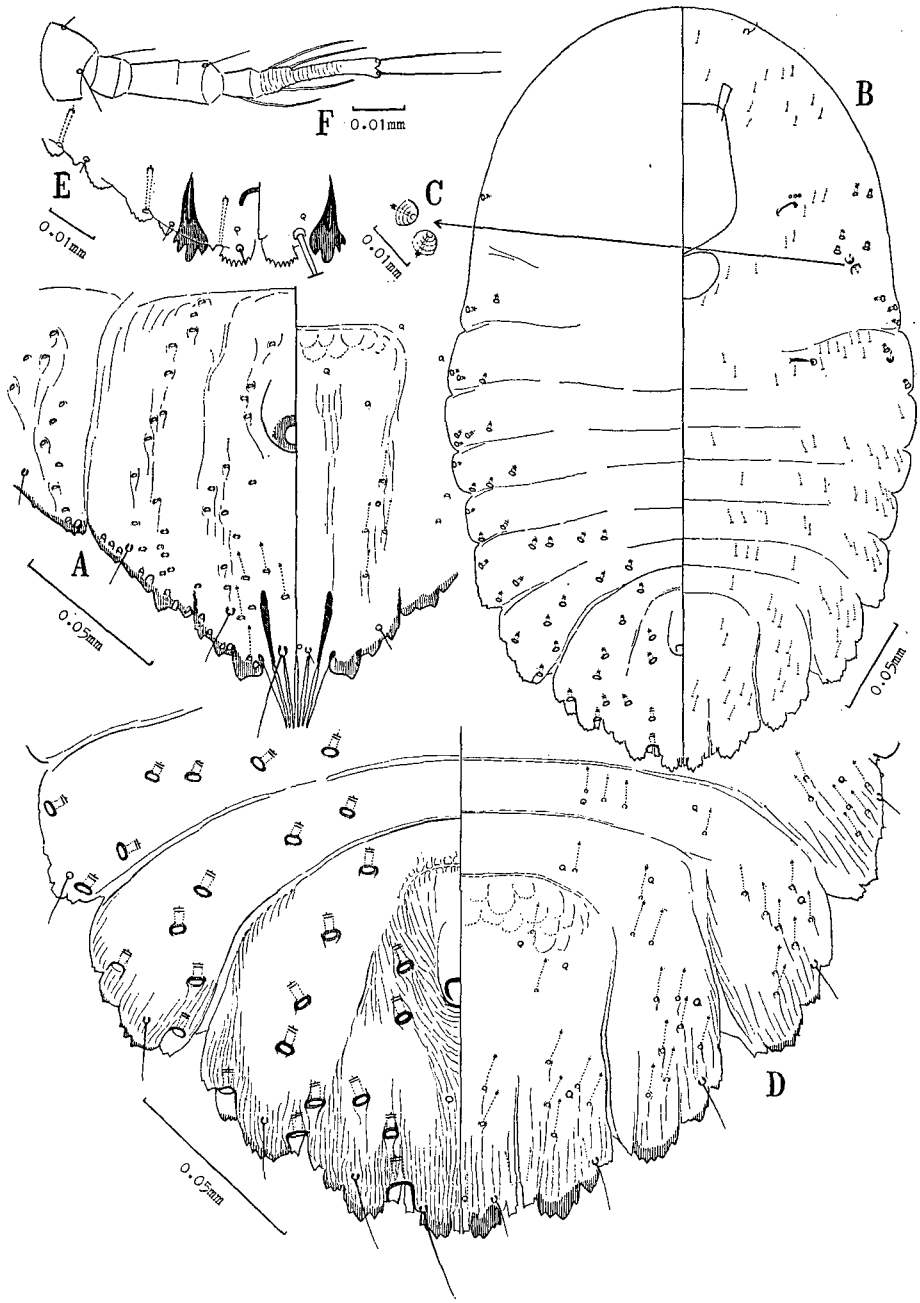

Fig. 18. *Odonaspis penicillata* Gr. A, second instar female (pygidium); B–D, second instar male (B, body; C, gland tubercles; D; pygidium); E & F, exuvium of the first instar larva (E, posterior extremity of the body; F, antenna).

similarity in the ducts and some other characters.

20. ***Odonaspis penicillata*** Green [Fig. 14 D ; 18]

References. Green *1905 a*: 346; Ferris *1938 a*: 164; Balachowsky *1953 g*: 738.

Diagnosis. Body oval, broadest across the thorax. Derm well sclerotized on the pygidium, slightly sclerotized and elaborately wrinkled on the prepygidial lateral area as far as the thorax, and minutely granulate-wrinkled laterally to both spiracles. Pygidium slightly roundish, the apex a little emarginate, with a tuft of six glanduliferous spiniform processes; marginal notch between the fifth and sixth abdominal segments deep, leading to a distinct intersegmental line on either surface. Marginal scleroses fusiform in two pairs, marking the intersegmental lines between the sixth and seventh and between the seventh and eighth abdominal segments. Gland tubercles absent on the thorax. Ducts quite small in size, thickly strewn over the pygidium on both surfaces and on the prepygidial lateral area, on the ventral side occurring anteriorly as far as the prothorax; a transverse row of ducts between the body margin and the mouth-parts in front of the anterior spiracle, another row between the body margin and the posterior spiracle. Antennae quite widely separated from each other and dislocated laterally. Anterior spiracle with four to 10 disc pores in a rather loose cluster; posterior spiracle without disc pores. Perivulvar pores absent.

Specimens examined. Yang-ming Shan and Heng-chun, on bamboo.

Distribution and host plants. This species was originally described from specimens collected in Ceylon on *Gigantochloa aspera* and later recorded in India, Taiwan, the Philippines, North America, Japan, Algeria, Hawaii and Micronesia (Caroline Is.) on various bamboos.

Remarks. This species is peculiar by having a tuft of glanduliferous spiniform processes at the apex of the pygidium. In other respects it is close to the type-species of the genus.

21. ***Odonaspis*** sp.

Specimens examined. Yang-ming Shan, on bamboo.

Remarks. This species comes close to *Odonaspis saccharicaulis* Zehntner by having gland tubercles on the pro- and mesothorax, by having three transverse rows of ventral ducts on each side of the thorax, etc., but differs from the latter by the posterior spiracles lacking disc pores, by the anterior spiracles each having a crescentic group of 38 to 55 disc pores, and by the fused median lobes more produced. Since the specimens at hand are few and in poor condition I keep from naming this species on the basis of these specimens.

Tribe **Aspidiotini**

XI. Genus ***Aspidiotus*** Bouché

References. Bouché *1833*: 52; Ferris *1938 a*: 190; ibid. *1941 e*; Balachowsky *1948 b*: 273; ibid. *1956*: 49.

Synonyms. *Cryptophyllaspis* Cockerell, 1897 [type-species: *Aspidiotus occultus* Green]; *Evaspidiotus* Leonardi, 1898 [type-species: *Chermes hederae* Vallot]; *Temnaspidiotus* MacGillivray, 1921 [type-species: *Aspidiotus excisus* Green].

Type-species. *Aspidiotus nerii* Bouché=*Chermes hederae* Vallot.

Diagnosis. Body broadly pyriform. Derm remaining membraneous in the prepygidial region (except in *capensis* Newstead); dorsum of the pygidium with a membraneous furrow arising just mesally to the third lobe (or between the sixth and seventh abdominal segments) and extending towards the anterolateral direction. Pygidial lobes in three pairs all well developed and parallel or practically so to the longitudinal axis of the body; no trace of the fourth pair. Median lobes more or less elongate, or as long as wide, thickly sclerotized, with a subapical notch on the outer or either side, in some species (*excisus* and others) sunken in a deep recess, which cuts the apex of the pygidium in a square and extends on each side as far as the mesal base of the second lobe; each median lobe continuous with a distinct and robust basal sclerosis, or with a vaguely defined, more or less sclerotized area extending into the pygidium from its base. Second and third lobes less sclerotized than the median, each usually with a deep notch on the outer side. Plates well developed, occurring laterally as far as the fifth abdominal segment; those on the fifth and sixth segments never with clavate processes, in many species fimbriate on the oblique outer margin. Marginal scleroses absent on the pygidium. Marginal setae of the pygidium all not lanceolate, though may be somewhat thickened; in many species the dorsal seta on the outer basal corner of the median lobe much elongate. Dorsal macroducts of the pygidium various in length (shortened and comparatively broad in the type-species), forming intersegmental rows at least between the sixth and seventh abdominal segments and between the seventh and eighth; in some species appearing rather scattered. Antennae widely separated from each other, each with a seta. Prosomatic tubercle sclerotized in a button, never prominent. Anal opening rather prominent in size, towards the apex of the pygidium. Perivulvar pores present in four or five groups.

Composition and distribution. In the present state of knowledge this genus is evidently Afro-Asiatic in its natural distribution, occurring in the whole continent of Africa across India and Ceylon to Japan, Taiwan, the Philippines and some oceanic islands of the Pacific. It comprises at least more than 30 described species.

Remarks. A revision of the genus was given by Ferris (*1941 e*), affording a basis for the recent conception of the genus, and, later, much was made of the African species of the genus by Balachowsky (*1956*). This genus is understood here after these authors.

I agree with Ferris (*1941 e*) in the opinion that *Temnaspidiotus* MacGillivray is a synonym of *Aspidiotus*. In his later work (*1952 a*) Ferris raised the former as a valid genus on the basis of the discovery of a new species in China, but that species should be referred to *Brainaspis* MacGillivray, which is a distinct genus composed of grass-feeding species (Balachowsky *1956*). The type-species of *Temnaspidiotus* has a deep recess at the apex of the pygidium and this is the reason for the separation of the genus from *Aspidiotus*. In the course of the present work I have found two other species which have such an apical recess on the pygidium: one of them is very close to *excisus*, whereas the other appears to be not particularly related with *excisus*. It seems that, taken by itself alone, the presence or absence of the apical recess of the pygidium can not be employed in making a generic or even infrageneric division in *Aspidiotus*.

So far as I am aware have been described or recorded from Taiwan the following species in *Aspidiotus*, of which two (*destructor* and *excisus*) should be retained in the

genus.

1) *chipponsanensis* Takahashi. Not collected.
2) *cyanophylli* Signoret. A species of *Hemiberlesia.*
3) *destructor* Signoret.
4) *euryae* Takahashi. Type-species of *Selenomphalus.*
5) *excisus* Green.
6) *implicatus* Maskell. A synonym of *lataniae.*
7) *lataniae* Signoret. A species of *Hemiberlesia.*
8) *machili* Takahashi. Referred to *Metaspidiotus.*
9) *phragmitis* Takahashi. Not collected.
10) *shakunagi* Takahashi. Referred to *Taiwanaspidiotus* (n. g.).
11) *stauntoniae* Takahashi. Type-species of *Metaspidiotus.*
12) *transparens* Green. A misidentification of *stauntoniae.*

In the course of the present work I have found five other species referable to *Aspidiotus,* of which one species is to be newly recorded from Taiwan and the other four to be described as new species.

22. ***Aspidiotus cryptomeriae*** Kuwana [Fig. 19 A; 29 A]

References. Kuwana *1902*: 69; ibid. *1933*: 4; Takagi *1957*: 32.

Diagnosis. Three pairs of pygidial lobes all of about the same shape and size. Median lobes a little extending beyond the apices of the second lobes, separated from each other by a space a little narrower than one of them, each lobe a little longer than broad, flatly rounded apically, with a notch on the outer side. Second and third lobes a little constricted basally. Plates scarcely extending beyond the apices of the lobes, eight laterally to the third lobe (on the fifth and sixth abdominal segments), those on the fifth segment tending to be reduced. Dorsal seta on the outer basal corner of the median lobe not particularly elongate. Dorsal macroducts of the pygidium not shortened; one marginal macroduct between the median lobes attaining the anal opening, one between the median and second, two between the second and third, two between the third lobe and the dorsal marginal seta of the fifth abdominal segment (Seta V), two or three between the dorsal marginal seta of the fourth segment (Seta IV) and Seta V, and one present or absent laterally to Seta IV; two to four submarginal macroducts between the seventh and eighth abdominal segments, five to eight in the intersegmental furrow between the sixth and seventh segments, three to seven in the furrow between the fifth and sixth segments, and one or two on the fifth segment. Anal opening about twice as long as the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about twice the diameter. Perivulvar pores in four or five groups, the median group absent or present (if present with four to seven disc pores), the anterolateral with eight to 14 disc pores, and the posterolateral with six to nine.

Specimens examined. Yang-ming Shan and Fen-chi-hu, on *Cryptomeria japonica.*

Distribution and host plants. This species occurs in Japan on various conifers such as *Abies firma, A. sachalinensis, Cephalotaxus harringtonia, Chamaecyparis obtusa, C. pisifera, Cryptomeria japonica, Picea excelsa, Pseudotsuga japonica, Taxus cuspidata, Torreya nucifera, Tsuga sieboldii,* etc. It was recorded in Korea on *Abies firma* and in southern Saghalien on *Taxus cuspidata.* So far as I am aware, this species has

hitherto been not recorded in Taiwan. It is possible that this species was introduced from Japan into Taiwan with *Cryptomeria japonica*, which is now planted in a large extent in Taiwan.

The record of this species by Ferris (*1953*) from Yunnan, China, on *Keteleeria evelyniana* is, as stated by Takahashi and Tachikawa (*1956*), erroneous: judging from Ferris' illustration the species from Yunnan differs from *cryptomeriae* by having numerous, scattered dorsal macroducts in the submarginal region of the fourth and fifth abdominal segments and by other details. Lindinger (*1911*) also recorded *cryptomeriae* from China on the basis of specimens collected at Tsingtau on *Juniperus chinensis*.

Remarks. This species was divided into two forms in Japan (Takagi, *1967*). One of these forms, to which all of the specimens at hand from Taiwan belong, is characterized by the pygidium less acute and the pygidial lobes shorter or more robust than in the other. It is not possible in the informations at hand to determine whether these two forms are distinct species or variants of any kind within a species.

23. ***Aspidiotus destructor*** Signoret [Fig. 19 B; 29 B]

References. Signoret *1869 a*: 120; Green *1896 e*: 49 [*lataniae*]; ibid. *1900 a*: 69 [*transparens* and *destructor*]; Ferris *1938 a*: 191; ibid. *1941 e*: 51; Balachowsky *1948 b*: 275; ibid. *1956*: 61.

Synonyms. The following species have been united with *destructor* by authors: *Aspidiotus transparens* Green, 1890; *Aspidiotus fallax* Cockerell, 1893; *Aspidiotus cocotis* Newstead, 1893; *Aspidiotus simillinus* var. *translucens* Cockerell, 1903 [pro *Aspidiotus transparens* Green, 1900, nec 1890]; *Aspidiotus oppugnatus* Silvestri, 1914.

Diagnosis. Median lobes separated from each other by about a half width of one of them, each lobe about twice as long as wide, slightly narrowing towards the apex, with a rather faint subapical notch on either side, the apical margin slightly slanting outwards and pauci-serrate. There is a range of variation in the size of the median lobes in comparison with the second: in one extremity (*translucens* form) of this variation the median lobes are rather large, projecting beyond the apices of the second lobes, whereas in the other extremity are surpassed by the second; these extremities are united by intermediate forms. Second lobes as wide as the median, a little constricted basally, with a deep notch on the outer side. Third lobes similar to the second, but a little smaller. Plates well developed, surpassing the lobes, eight laterally to the third lobe (on the fifth and sixth abdominal segments), those on the fifth segment tending to be reduced. Dorsal seta on the outer basal corner of the median lobe long and slender. Macroducts of the pygidium not shortened; one marginal macroduct between the median lobes attaining the anal opening, one between the median and second, two between the second and third, two between the third lobe and the dorsal marginal seta of the fifth abdominal segment, and one or two between the dorsal marginal setae of the fourth and fifth segments; one or two submarginal macroducts between the seventh and eighth abdominal segments, four to eight in the intersegmental furrow of the sixth and seventh, three to six in the furrow between the fifth and sixth, and occasionally one or two on the fifth. Anal opening about twice as long as the median lobe in its longitudinal diameter, removed from the bases of the median lobes by twice, or less than twice, the diameter. Perivulvar pores in four or five groups, the median group absent or rarely present (with one to three disc pores), the anterolateral with five to 14, and the posterolateral with four to nine.

Specimens examined. Tai-pei, on palm; Kuan-tzu-ling, on orange tree and *Os-*

manthus asiaticus; Chu-chi, on mango tree.

Distribution and host plants. This species is a well-known pest of coco palm and many other plants in the tropics and other warm parts of the world.

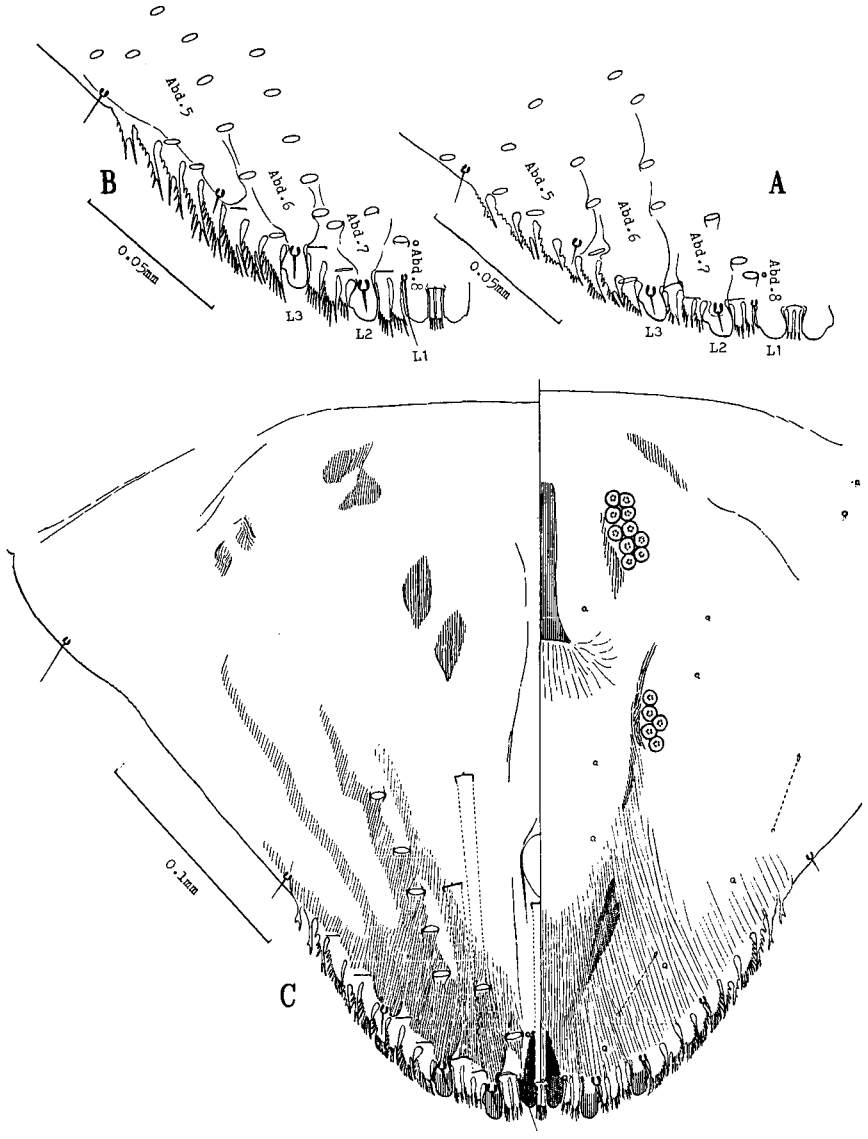

Fig. 19. A–C, adult female (pygidium). A, *Aspidiotus cryptomeriae* Kuw.; B, *Aspidiotus destructor* Sign.; C, *Aspidiotus beilschmiediae*, n. sp.

Remarks. The specimens at hand from Taiwan are somewhat variable in the size of the median lobes in comparison with the second lobes, yet they are all fairly uniform in other characters. I have little doubt that these specimens belong to a single species and that *translucens* is a mere variant of *destructor*.

24. ***Aspidiotus beilschmiediae***, n. sp. [Fig. 19 C ; 29 C]

Diagnosis. Pygidium produced, rather acute. Median lobes separated from each other by a half width of one of them, longer than wide, a little narrower towards the apex, with a slight subapical notch on either side. Second and third lobes prominent, about as large as the median, a little constricted basally and flatly rounded apically, with a deep notch on the outer side. Plates well developed, about 10 laterally to the third lobe (on the fifth and sixth abdominal segments), those on the fifth segment tending to be reduced. Dorsal seta on the outer basal corner of the median lobe long and slender. Macroducts of the pygidium not shortened, comparatively wide, and few in number ; one marginal macroduct between the median lobes attaining the anal opening, one between the median and second, two between the second and third, two between the third and the dorsal marginal seta of the fifth abdominal segment, and two between the dorsal marginal setae of the fourth and fifth segments. Two submarginal macroducts between the seventh and eighth abdominal segments (one in front of the marginal macroduct between the median and second lobes, and one in front of the second lobe more removed anteriorly) ; four to six forming a single row in the intersegmental furrow between the sixth and seventh abdominal segments, the posteriormost macroduct of this row removed from the pygidial margin ; and one or two present or absent laterally to the row. Prepygidial region of the body with microducts scattered just within the margin. Anal opening about twice as long as the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about thrice the diameter. Perivulvar pores in four groups, eight to 10 in the anterolateral group, and four to six in the posterolateral.

Specimens examined. Fen-chi-hu, on *Beilschmiedia erythrophloia* [three adult females.]

Remarks. This species is very close to *destructor*. It is tentatively distinguished from the latter on the basis of several little details : in comparison with *destructor* this species is characterized by the pygidium more acute, the anal opening more removed from the bases of the median lobes, and the plates tending to be more numerous laterally to the third lobe. Moreover, so far as compared on the basis of the Taiwanese specimens at hand *beilschmiediae* differs from *destructor* by having dorsal macroducts much less numerous.

25. ***Aspidiotus watanabei***, n. sp. [Fig. 20 A, B ; 29 D]

Diagnosis. Pygidium produced, with a wide recess apically between the second lobes. Median lobes large, yet a little surpassed by the second lobes owing to their position in the apical recess, separated from each other by a narrow space, each lobe about twice as long as wide, evidently larger than the lateral lobes, a little narrowing halfway towards the apex, with a subapical notch on either side, and with the apical margin minutely serrate. Second lobes slightly constricted basally, flatly rounded apically, with a notch towards the apex on the outer side. Third lobes similar to the second in shape, but a little smaller. Plates well developed on the pygidium, eight laterally to the third lobe. Dorsal seta on the outer basal corner of the median lobe elongate, but scarcely extending beyond the apex of the lobe. Dorsal macroducts of the pygidium not shortened, relatively broad, few in number : one marginal macroduct between the median lobes attaining the anal opening, one between the median and

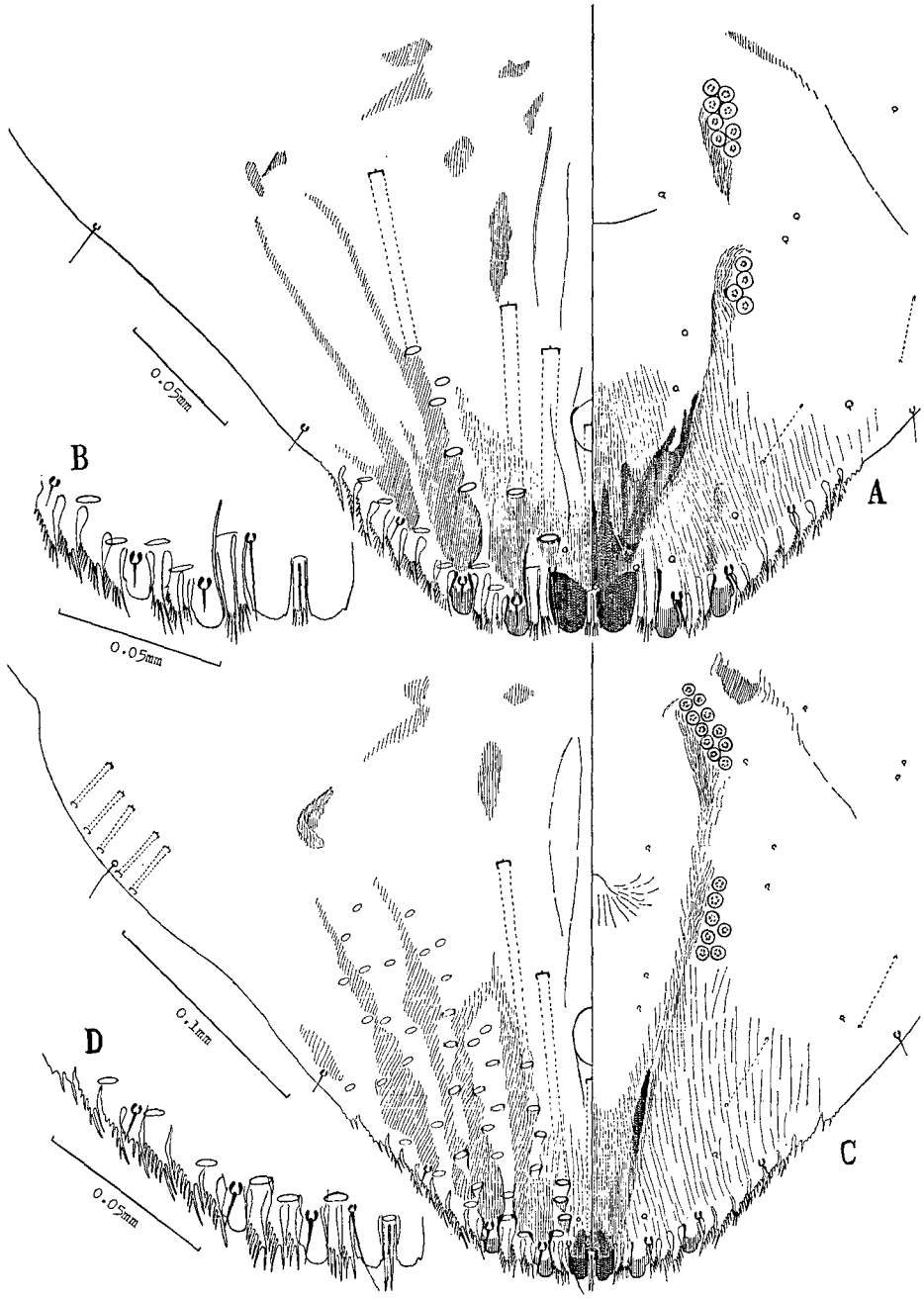

Fig. 20. A–D, adult females (A & C, pygidium; B & D, pygidial margin). A & B, *Aspidiotus watanabei*, n. sp.; C & D, *Aspidiotus pothos*, n. sp.

second lobes, two between the second and third, two between the third and the dorsal marginal seta of the fifth abdominal segment, and two between the dorsal marginal setae of the fourth and fifth abdominal segments; two submarginal macroducts on the seventh and eighth abdominal segments, four or five forming a single row in the intersegmental furrow between the sixth and seventh abdominal segments, usually absent (or rarely one present) laterally to this row. Anal opening about as long as the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about twice the diameter. Perivulvar pores in four groups, seven to 10 in the anterolateral group, and three to five in the posterolateral.

Specimens examined. Fen-chi-hu, on *Viburnum arboricolum*.

Remarks. This species is close to the preceding two (*destructor*; *beilschmiediae*, n. sp.), from which it is distinguished by the pygidium evidently recessed apically, the median lobes apparently larger than the second and separated from each other by a narrow space, the dorsal seta on the outer basal corner of the median lobe scarcely extending beyond the apex of the lobe, the anal opening smaller and removed less from the bases of the median lobes (in comparison with *beilschmiediae*), and the plates fewer laterally to the third lobe (in comparison with *beilschmiediae*).

26. ***Aspidiotus pothos***, n. sp. [Fig. 20 C, D; 30 A]

Diagnosis. Pygidium broad. Median lobes separated from each other by a narrow space, a little or scarcely projecting beyond the apices of the second, slightly convergent or practically parallel, each lobe longer than broad, with a subapical notch on the outer side. Second lobes practically as large as or a little smaller than the median, with a deep notch on the outer side. Third lobes similar to the second in shape, but slightly smaller. Plates well developed, projecting beyond the apices of the lobes; two plates slender and not fimbriate between the median lobes; eight plates laterally to the third lobe. Dorsal seta on the outer basal corner of the median lobe long and slender, extending beyond the apex of the lobe. Macroducts of the pygidium slender and numerous; one marginal macroduct attaining the anal opening; 31 to 42 macroducts (including both marginal and submarginal) mostly in three intersegmental rows on each side, these rows are broad and irregular and at times are partly confluent with each other. Much smaller macroducts along the margin of the prepygidial region of the abdomen: absent or one macroduct present on the first abdominal segment, two to four on the second, and three to five on the third. Many microducts along the margin of the whole prepygidial region of the body, each opened in a minute, spinous or tubercular process. Anal opening longer than the median lobe in its longitudinal diameter, removed from the bases of the median lobes more than twice the diameter. Perivulvar pores in four groups, eight to 13 in the anterolateral group, and four to nine in the posterolateral.

Specimens examined. Southeastern Tai-pei Hsien, on *Pothos seemannii*.

Remarks. This species is similar to certain African species studied by Balachowsky (*1956*), among which *Aspidiotus fularum* Balachowsky should be here brought to comparison on the basis of Balachowsky's description and illustration. By having numerous dorsal macroducts and other characters the new species is close to *fularum*, but may be distinguishable from the latter by the median lobes set close together, the median pair of marginal plates of the pygidium slender and not fimbriate, the dorsal

macroducts of the pygidium arranged mostly in three broad intersegmental furrows on each side (in *fularum* the dorsal macroducts are arranged in four rows on each side of the pygidium), and the presence of many microducts along the margin of the whole prepygidial region. In the pygidial margin the new species somewhat resembles *destructor*, from which it is easily distinguishable by having numerous macroducts on the pygidium and by having macroducts on the prepygidial abdominal segments.

27. ***Aspidiotus hoyae***, n. sp. [Fig. 21 A, B; 30 B]

Diagnosis. Pygidium broad, with the apex widely recessed between the second lobes. Median lobes as long as or a little longer than the second (both measured on the outer side), yet surpassed by the apices of the latter owing to the position in the recess, separated from each other by a space which is about two-thirds as wide as one of them, each lobe a little longer than wide, with a subapical notch on the outer side. Second lobes broadly rounded apically, not notched. Third lobes similar in shape to the second, but apparently smaller. Plates well developed on the pygidium, eight laterally to the third lobe. Dorsal seta on the outer basal corner of the median lobe long and slender, extending beyond the apex of the lobe. Submarginal dorsal macroducts present as far as the second or third abdominal segment, shortened and slender; one marginal macroduct between the median lobes scarcely attaining a half distance between the anal opening and the bases of the median lobes; 27 to 45 macroducts (including both marginal and submarginal) on each side of the body, towards the apex of the pygidium mostly in intersegmental furrows, but otherwise scattered towards the anterolateral corner of the pygidium and on the prepygidial segments. One to four smaller macroducts present along the margin of the second abdominal segment, and three to five along the margin of the third. Anal opening about twice as long as the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about twice the diameter. Perivulvar pores normally in four groups, nine to 17 in the anterolateral group, and seven to 10 in the posterolateral group.

Specimens examined. Southeastern Tai-pei Hsien, on *Hoya carnosa*.

Remarks. This species comes close to *excisus*, from which it is distinguished by the apical recess of the pygidium less deep, the median lobes smaller in comparison with the second, and the third lobes robust, being about as long as wide.

28. ***Aspidiotus excisus*** Green [Fig. 21 C, D; 30 C]

References. Green *1896 e*: 53; Ferris *1941 e*: 53.

Diagnosis. Pygidium broad, with the apex widely and deeply recessed between the second lobes. Median lobes large, about twice as long as the second (both measured on the outer side), yet, being sunken in the apical recess of the pygidium, surpassed by the apices of the second lobes, separated from each other by a space which is about one-third as wide as one of them, each lobe with a subapical notch on either side, and with the apical margin slightly slanting outwards and minutely serrate. Second lobes much smaller than the median, yet prominent, rounded apically. Third lobes much narrower than the second. Plates extending beyond the apices of the lobes, six to eight laterally to the third lobe. Dorsal seta on the outer basal corner of the median lobe elongate, extending beyond the apex of the lobe. Submarginal dorsal macroducts numerous, present as far as the third abdominal segment, shortened, and slender; one marginal macroduct between the median lobes scarcely attaining a half distance between

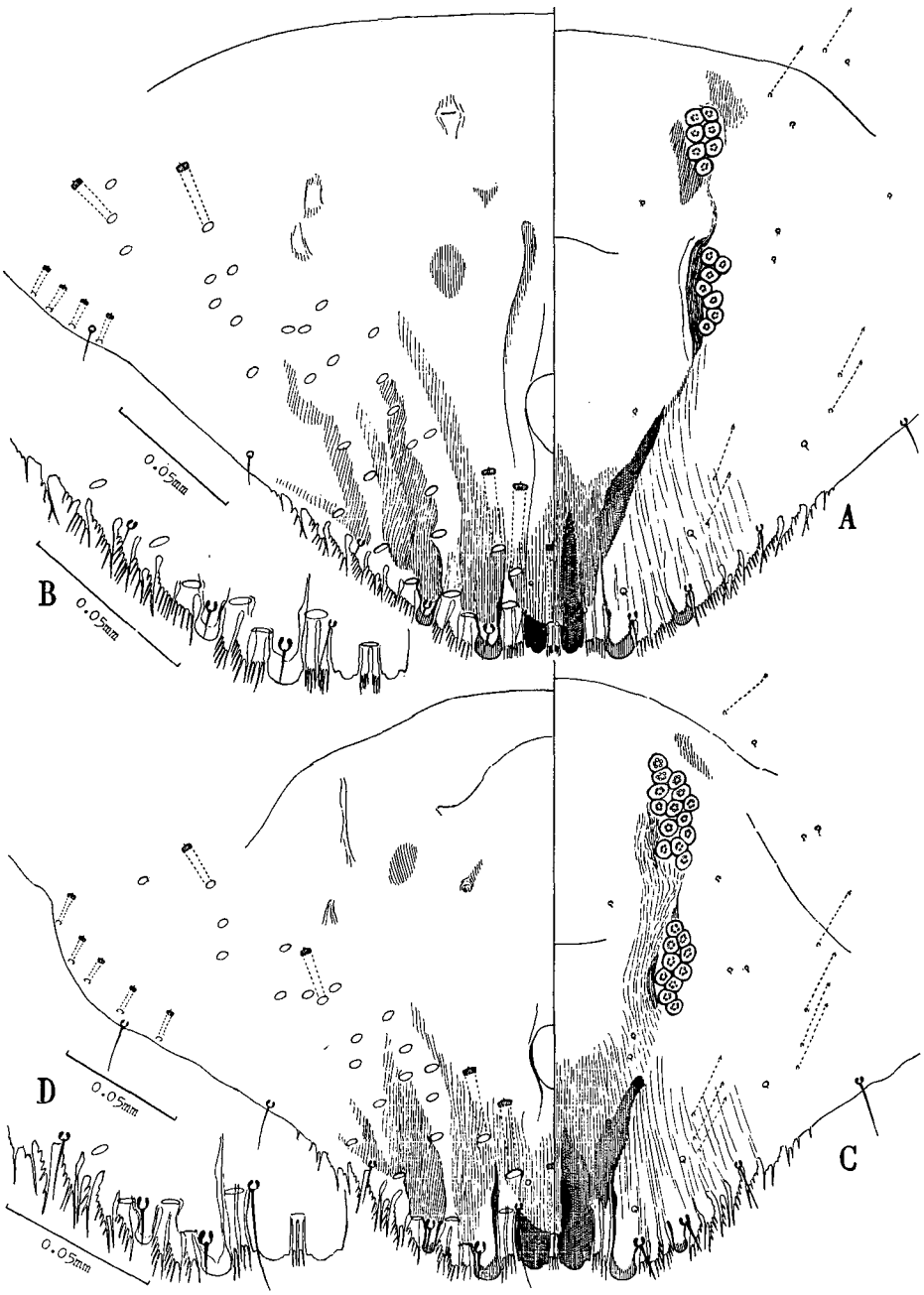

Fig. 21. A–D, adult females (A & C, pygidium; B & D, pygidial margin). A & B, *Aspidiotus hoyae*, n. sp.; C & D, *Aspidiotus excisus* Gr.

the anal opening and the bases of the median lobes; 23 to 47 macroducts (including both marginal and submarginal) on each side of the body almost scattered. Four or five smaller macroducts present on the margin of the second and third abdominal segments each. Anal opening as long as or a little longer than the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about twice the diameter. Perivulvar pores in four or five groups, one to seven or absent in the median group, seven to 14 in the anterolateral group, and five to 10 in the posterolateral group.

Specimens examined. Pei-tou, on *Elephantopus mollis*.

Distribution and host plants. This species was originally described from Ceylon as a feeder of *Cyanotis pilosa*. Later, it was recorded on *Ipomea* in Ceylon; on *Musa* and *Piper* in Fiji; on coconut, *Tournefortia*, banana, citrus, papaya, *Thespesia* and other plants in Micronesia; and also in Thailand. In Taiwan, it was recorded by Takahashi from the following plants: *Clerodendron neriifolium*, *Elephantopus mollis*, *Glochidion hongkongense*, *Hoya carnosa*, *Rhododendron* sp., *Rhus semialata*, *Urena lobata* and *Viburnum* sp.

XII. Genus ***Taiwanaspidiotus***, n. g.

Type-species. *Aspidiotus shakunagi* Takahashi.

Diagnosis. Body narrowly pyriform or obovate, with the pygidium produced. Derm of the pygidial dorsum practically evenly sclerotized, without distinct membraneous intersegmental furrows. Pygidial lobes in three pairs, the median lobes largest and set close together. Plates well developed between the lobes and on the sixth abdominal segment, but quite reduced or obsolete on the fifth abdominal segment, two between the median lobes quite slender, two between the median and second lobes and three between the second and third lobes fimbriate apically. Dorsal macroducts of the pygidium long, with orifice transversely elliptical and surrounded by a slender, sclerotized rim; submarginal macroducts few between the seventh and eighth abdominal segments, some macroducts on the area of the fifth to seventh segments. Antennae widely separated from each other, with a seta. Both pairs of spiracles without disc pores. Anal opening longitudinally elliptical, at the posterior one-third of the pygidium. Perivulvar pores present in the type-species.

Composition and distribution. The type-species and a new species described hereinafter are known only from Taiwan. *Aspidiotus pangoensis* Doane and Ferris, which was originally described from Samoa, has some resemblance to the type-species.

Remarks. The type-species is close to the species of *Aspidiotus*, but can not be retained in that genus owing to the narrower body, the evenly sclerotized dorsal derm of the pygidium, and the reduction of plates on the fifth abdominal segment. The new species *yiei* is identical with the type-species in these characters, although it is peculiar in the shape of the body and also of the pygidial lobes. The erection of the new genus is rather tentative until comparative studies on the basis of further species have been made.

29. ***Taiwanaspidiotus shakunagi*** (Takahashi) [Fig. 22; 30 D]

References. Takahashi *1935*: 32 [*Aspidiotus*].

Diagnosis. Body rather narrowly obovate. Median lobes large, as long as or a little longer than wide, flatly rounded apically, notched or serrate on both sides subapically,

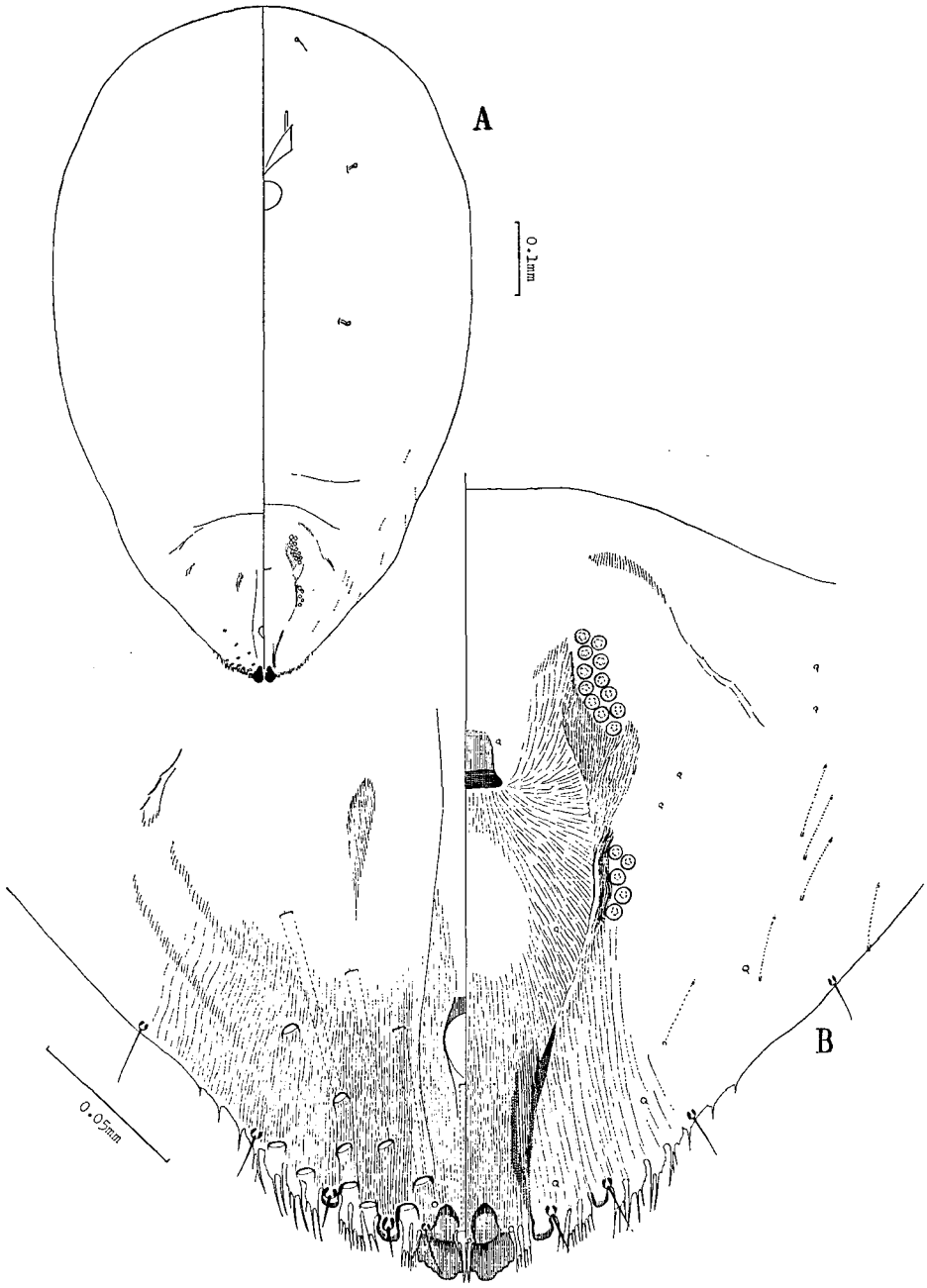

Fig. 22. *Taiwanaspidiotus shakunagi* (Takah.). Adult female (A, body ; B, pygidium).

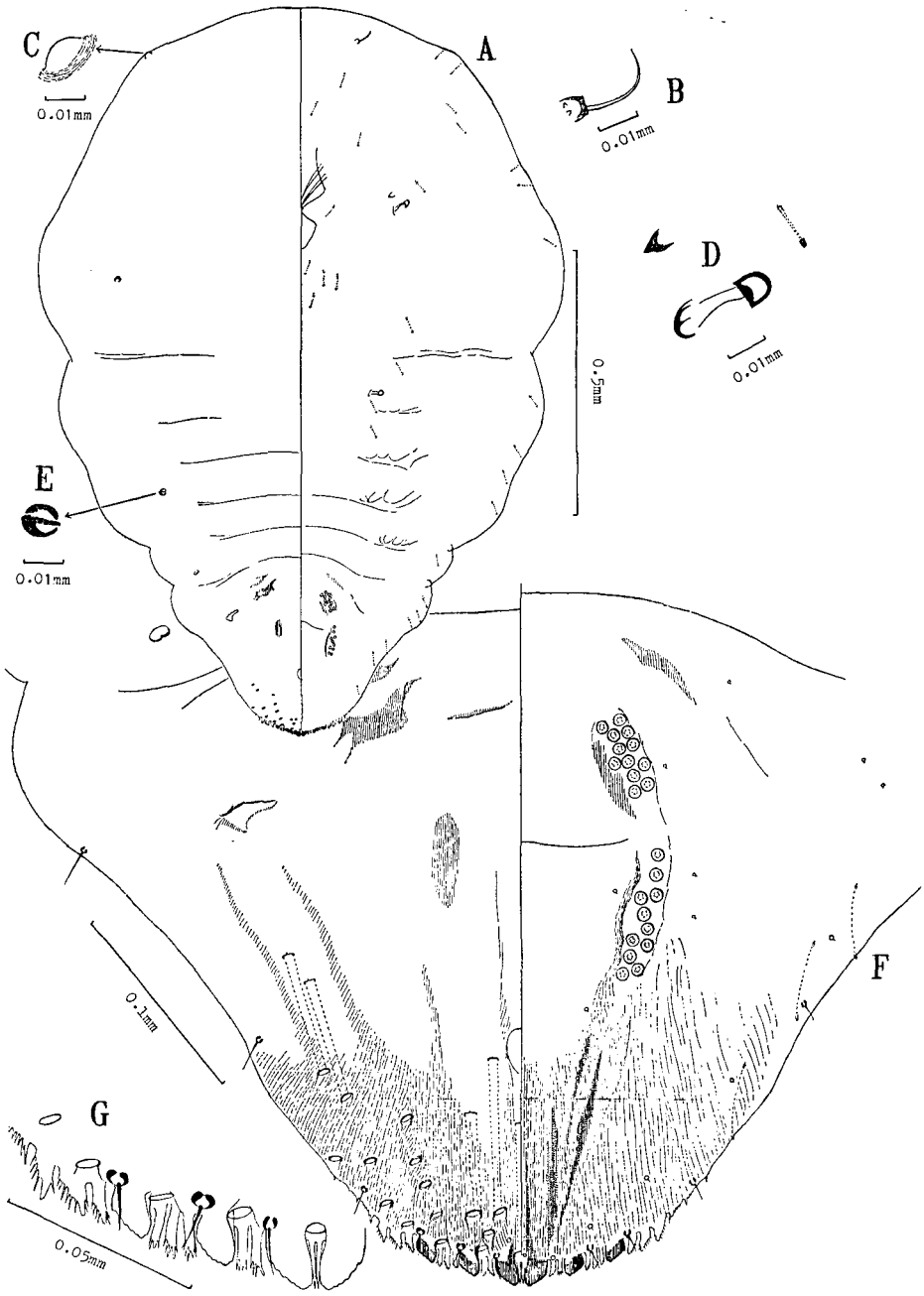

Fig. 23. *Taiwanaspidiotus yiei*, n. sp. Adult female (A, body; B, antenna; C, prosomatic tubercle; D, anterior spiracle, with a spine; E, submarginal dorsal boss; F, pygidium; G, pygidial margin).

each with a robust basal sclerosis. Second lobes much smaller than the median, with a subapical notch on the outer side. Third lobes similar in shape to the second, but smaller. Plates occurring laterally to the third lobe with a few slender processes. One marginal macroduct between the median lobes almost attaining the anal opening, one between the median and second lobes, two between the second and third lobes, two between the third lobe and the dorsal marginal seta of the fifth abdominal segment (Seta V), and one at times present laterally to Seta V; one submarginal macroduct just anteriorly to the marginal macroduct between the median and second lobes, and four to seven in the supposed region of the fifth to seventh abdominal segments. Anal opening a little longer than the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about twice the diameter. Perivulvar pores in four or five groups, none or one to three disc pores in the median group, six to 13 in the anterolateral group, and four to eight in the posterolateral group.

Specimens examined. A-li Shan, on *Rhododendron* sp.

Distribution and host plants. This species is known only from Taiwan as a feeder of *Rhododendron*.

Remarks. In the specimens at hand the marginal setae of the fifth to seventh abdominal segments are not so much thickened as figured in the original description. Since in other main characters these specimens agree with the original description I have little doubt that they are correctly identified with *shakunagi*.

30. ***Taiwanaspidiotus yiei***, n. sp. [Fig. 23; 31 A]

Diagnosis. Body narrowly pyriform, constricted between the prosoma and metathorax, gently lobed out in the last prepygidial segment and the base of the pygidium, and rather rounded around the apex of the pygidium. Derm tending to be sclerotized throughout at maturity. Median lobes as long as or slightly longer than wide, convergent, with the outer margin serrate. Second and third lobes similar in shape to, but a little smaller than, the median, well sclerotized. Plates short-fimbriate. One marginal macroduct between the median lobes as long as three-fourths the distance between the anal opening and the bases of the lobes, one between the median and second lobes, one between the second and third lobes, usually two between the third lobe and the dorsal marginal seta of the fifth abdominal segment (Seta V), and one laterally to Seta V; three submarginal macroducts just anteriorly to the marginal macroduct between the median and second lobes (between the seventh and eighth abdominal segments), four or five in a single oblique row between the sixth and seventh abdominal segments, and two to five laterally to this row. Prosomatic tubercles flat and sclerotized. A sclerotized robust spine in front of the anterior spiracle. Anal opening a little longer than the median lobe in its longitudinal diameter, at the posterior third of the pygidium. Perivulvar pores in four groups, eight to 13 in the anterolateral group, and seven to 12 in the posterolateral.

Specimens examined. Fen-chi-hu, on the leaves of *Castanopsis kusanoi* [four adult females].

Remarks. This species is distinguishable from *shakunagi* by the peculiar shape of the body and also by the pygidial lobes and other characters. Although this species appears to be rather remote from the type-species of the genus, I am inclined to believe that it may be better placed in *Taiwanaspidiotus* than in any other genus known to me.

XIII. Genus ***Hemiberlesia*** Cockerell

References. Cockerell *1897 i*: 30; Ferris *1938 a*: 214, 232 and 255 [*Diaspidiotus, Hemiberlesia* and *Quadraspidiotus*]; Balachowsky *1948 b*: 297 and 306 [*Hemiberlesia* and *Abgrallaspis*]; ibid. *1950 b*: 397 and 488 [*Quadraspidiotus* and *Diaspidiotus*]; ibid. *1956*: 14 and 104 [*Abgrallaspis* and *Hemiberlesia*]; ibid. *1958 b*: 210 [*Quadraspidiotus*]; Davidson 1964, Ent. Soc. Amer. Ann. 57: 638 [*Abgrallaspis*].

Synonyms. *Diaspidiotus* Berlese, 1896 [type-species: *Diaspidiotus patavinus* Berlese=*Aspidiotus pyri* Lichtenstein] (after De Lotto); *Diaspidiotus* Leonardi, 1898, nec Berlese [type-species: *Diaspis ancylus* Putnam]; *Marlattaspis* MacGillivray, 1921 [type-species: *Aspidiotus implicatus* Maskell=*Aspidiotus lataniae* Signoret]; *Quadraspidiotus* MacGillivray, 1921 [type-species: *Aspidiotus ostreaeformis* Curtis]: *Forbesaspis* MacGillivray, 1921 [type-species: *Aspidiotus forbesi* Johnson]; *Chemnaspidiotus* MacGillivray, 1921 [type-species: *Cryptophyllaspis liquidambaris* Kotinsky]; *Euraspidiotus* Thiem and Gerneck, 1934 [type-species: *Aspidiotus ostreaeformis* Curtis]; *Ephedraspis* Borchsenius, 1949 [type-species: *Aspidiotus ephedrarum* Lindinger]; *Abgrallaspis* Balachowsky, 1948 [type-species: *Aspidiotus cyanophylli* Signoret]; after Ferris the followings are also synonyms of *Hemiberlesia*, having the same type-species with the latter: *Aspidites* Berlese and Leonardi, 1896, nec Waagen, 1895, and *Hemiberlesiana* Thiem and Gerneck, 1934.

Type-species. *Aspidiotus rapax* Comstock.

Diagnosis. Body pyriform, with the pygidium broadly rounded. Pygidium at least with the median pair of lobes well developed and robust. Plates present or absent on the pygidium, if present various in shape, but at least not broadened. Short, fusiform marginal scleroses present on the pygidium, bordering the intersegmental furrows between the sixth and seventh and also the seventh and eighth abdominal segments, at times tending to be reduced between the sixth and seventh. Dorsal macroducts various in shape, always few in the furrow between the seventh and eighth abdominal segments. Antennae each with a seta. Both pairs of spiracles without disc pores. Anal opening towards the apex of the pygidium, various in size. Perivulvar pores present or absent.

Composition and distribution. As given above in the list of synonyms a trial is here taken to unite most of the species hitherto referred to *Hemiberlesia, Diaspidiotus, Quadraspidiotus* and *Abgrallaspis* into a single genus. In this composition the genus *Hemiberlesia* receives a quite large number of species from various parts of the world. It is not easy to come to any satisfactory conclusion on the composition and distribution of the genus within the limited informations available.

Remarks. It is the opinion here adopted that *Hemiberlesia, Diaspidiotus, Quadraspidiotus* and *Abgrallaspis*, which have been accepted as distinct genera by recent authors, should be united into a single genus. These genera, which are common in some characters, have been distinguished from each other mainly or exclusively by the characters of the pygidial processes, that is, the lobes and the plates, but Stannard (1965, Ent. Soc. Amer. Ann. 58: 573) shows that these characters are not always invariable. After him, *Abgrallaspis howardi* Cockerell and *Abgrallaspis comstocki* Johnson are, in reality, leaf-feeding forms of *Diaspidiotus ancylus*, which is the bark-feeding form of this variable species. Accepting this combination of ecophenotypic polymorphism, I am very much inclined to the opinion that *Diaspidiotus* Leonardi (nec Berlese) and *Abgrallaspis* can not be distinguished from each other, because *D. ancylus* is the type-species of *Diaspidiotus* and *A. howardi* and *A. comstocki* are very similar to the type-species of *Abgrallaspis*, *A. cyanophylli*, in the pygidial fringe. Somewhat grave differences

between *ancylus* and *cyanophylli* are found in that the anal opening is small in *ancylus*, whereas relatively large in *cyanophylli*; and in that the median lobes are parallel and separated from each other by a good space in *cyanophylli*, whereas convergent and set close in *ancylus*. Taking their related species, however, into consideration, I can not any longer accept these differences as having significance in separating distinct groups: all these species form an intergraded series concerning either the median lobes and the anal opening.

Quadraspidiotus (=*Diaspidiotus* Berlese, nec Leonardi) is very close to *Diaspidiotus* Leonardi (nec Berlese) and the two are not always easily distinguishable from each other. The former has been distinguished from the latter exclusively by the presence of sclerotized and convergent second lobes. Because the second lobes in the leaf-feeding forms of *Diaspidiotus ancylus* are well developed and sclerotized, though little convergent, there seems now to be little room to accept *Quadraspidiotus* as distinct from *Diaspidiotus*.

Hemiberlesia, as understood by Balachowsky and others, and *Abgrallaspis* are close, and seem to be not clearly distinguishable from each other. The type-species of the former is characterized by the enormously large anal opening, but there are between the type-species of the two genera various species which connect these genera concerning the anal opening as well as the pygidial margin and the dorsal ducts. One of such species is *Hemiberlesia palmae* Morgan and Cockerell, which was referred to *Abgrallaspis* by Balachowsky in 1948 and returned to *Hemiberlesia* by himself in 1956. After all, the four genera may be better united, and most of the species hitherto referred to these genera may be included within the single genus *Hemiberlesia*. It should be added here that some species, *perniciosus* and allied, which are referred to *Quadraspidiotus* by recent authors, have a certain peculiar character in common and so can not be easily thrown into the enlarged genus *Hemiberlesia* together with the other *Quadraspidiotus*-species. In that case *Comstockaspis* MacGillivray, of which the type-species is *Aspidiotus perniciosus* Comstock, might tentatively be kept as a valid genus.

31. ***Hemiberlesia rapax*** (Comstock) [Fig. 31 B]

References. Comstock *1881 a*: 307 [*Aspidiotus*]; Ferris *1938 a*: 244; Balachowsky *1948 b*: 299; ibid. *1956*: 116.

Synonyms. The followings were synonymized with this species by authors, but some of them remain uncertain about their identity: *Aspidiotus camelliae* of Signoret, 1869, and others; *Aspidiotus acuminatus* Targioni, 1877; *Aspidiotus convexus* Comstock, 1881 (partim); *Aspidiotus euonymi* Targioni, 1888; *Aspidiotus flavescens* Green, 1890; *Diaspis circulatus* Green, 1896; *Aspidiotus tricolor* Cockerell, 1897; *Aspidiotus lacumae* Cockerell, 1899; and *Hemiberlesia argentina* Leonardi, 1911.

Diagnosis. Median lobes robust, convergent and set close together, with a pair of slender plates between them. Second and third lobes quite small, pointed apically, little sclerotized. Plates well developed and mostly divided apically between the median and third lobes; three simple plates laterally to the third lobe. Dorsal macroducts quite slender; two enclosed by the marginal scleroses between the seventh and eighth abdominal segments (between the median and second lobes); four to eight in a row between the sixth and seventh, the posteriormost of them enclosed by the marginal scleroses; and two to four in a submarginal row between the fifth and sixth, this row attaining the laterobasal sclerosis of the pygidium. Submarginal ventral microducts abundant on the metathorax and the first to fifth abdominal segments. Anal opening

rounded, much longer than the median lobe in its diameter, quite close to the apex of the pygidium. Perivulvar pores absent.

Specimens examined. Fen-chi-hu, on *Actinidia arisanensis*.

Distribution and host plants. This species occurs widely in the tropics and other warm parts of the world and also in greenhouses in the temperate region, feeding on various kinds of plants. Takahashi recorded it in Taiwan from *Ilex* sp. under the name *Diaspidiotus camelliae*.

32. ***Hemiberlesia lataniae*** (Signoret) [Fig. 31 C]

References. Signoret *1859 a*: 124 [*Aspidiotus*]; Ferris *1938 a*: 241; Balachowsky *1948 b*: 302; ibid. *1956*: 108.

Synonyms. *Aspidiotus cydoniae* Comstock, 1881; *Aspidiotus punicae* Cockerell, 1893; *Aspidiotus diffinis* var. *laterallis* Cockerell, 1894; *A.* (*Hemiberlesia*) *crawii* Cockerell, 1897; *Aspidiotus cydoniae* var. *tectus* Maskell, 1897; *A.* (*Diaspidiotus*) *greeni* Cockerell, 1897; *Aspidiotus implicatus* Maskell, 1898.

Diagnosis. Median lobes robust, convergent and set close together, with a pair of quite slender plates between them. Second and third lobes each represented by a quite small, membraneous, pointed process, the third lobes at times obsolete. Plates well developed and mostly fimbriate between the median and third lobes, those laterally to the third lobes tending to be reduced and at times obsolete. Dorsal macroducts quite slender; one between the median lobes, extending anteriorly beyond the anal opening; two enclosed by the marginal scleroses of the seventh and eighth abdominal segments (between the median and second lobes); five to 10 in a row between the sixth and seventh, the posteriormost enclosed by the marginal scleroses and the anteriormost often attaining the laterobasal sclerosis of the pygidium; three to six in a row between the fifth and sixth, this row usually attaining the laterobasal sclerosis; and one submarginal macroduct at times on the fifth. Anal opening rounded, about as long as the median lobe in its diameter, removed from the bases of the median lobes by a little more than this diameter. Perivulvar pores in four groups, two to 10 in the anterolateral group, and one to seven in the posterolateral group.

Specimens examined. Yang-ming Shan, on *Melastoma candidum* and *Rhododendron* sp.; Kuan-tzu-ling, on *Ardisia sieboldii*, *Litsea akoensis*, orange tree and *Saurauia tristyla* var. *oldhamii*; Kao-hsuing, on *Juniperus* sp.; Heng-chun, on *Diospyros discolor*; Kenting, on *Cycas* sp., *Garcinia spicata*, *Latania commersonii*, palm, *Psidium guajava* and *Ravenala madagascariensis*.

Distribution and host plants. This species is widely distributed in the tropics and other warm parts of the world and also in greenhouses in the temperate region, feeding on various kinds of plants. Takahashi recorded it in Taiwan from the following plants: *Citrus* spp., *Cocos nucifera*, *Cycas revoluta*, *Cymbidium sinense*, *Diospyros discolor*, *Hibiscus rosae-sinensis*, *Mangifera indica*, *Morus alba* and *Vitis vinifera*.

Remarks. The specimens collected at Kao-hsuing on *Juniperus* are characterized by the perivulvar pores quite few in number, but otherwise not distinguishable from the others.

33. ***Hemiberlesia cyanophylli*** Signoret [Fig. 31 D]

References. Signoret *1869 a*: 119 [*Aspidiotus*]; Ferris *1938 a*: 237; Balachowsky *1948 b*: 322 [*Abgrallaspis*]; ibid. *1956*: 16 [*Abgrallaspis*].

Diagnosis. Pygidium with three pairs of lobes sclerotized, but the second and third

lobes less so in comparison with the median, all parallel to the longitudinal axis of the body; fourth lobe reduced to a mere marginal serration. Median lobes robust, about as long as wide, separated from each other by a space a little or scarcely narrower than half the width of one of them, with a deep subapical notch on each side. Second lobes much narrower and a little shorter than the median, and lanceolate. Third lobes smaller than the second, conical or rather lanceolate. Plates well developed in the interlobar spaces, extending beyond the apices of the lobes, and well fimbriate, those laterally to the third lobe slender and less fimbriate. Dorsal macroducts of the pygidium long; one marginal macroduct between the median lobes attaining the anal opening, one between the median and second lobes enclosed by a pair of small marginal scleroses, and two between the second and third lobes with the rim of the orifice sclerotized; one or two macroducts are practically marginal in position laterally to the third lobe; one submarginal macroduct between the median and second lobes (between the seventh and eighth abdominal segments) just in front of the marginal macroduct, four or five in a row between the sixth and seventh abdominal segments, and one to three towards the anterolateral corner of the pygidium. Much smaller macroducts along the margin of the prepygidial region: one or two on the mesothorax, two or three on the metathorax, two on the basal two abdominal segments each, and one or two on the third abdominal segment. Prosomatic tubercles conical and sclerotized. Anal opening rounded, longer than the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about this diameter. Perivulvar pores normally in four groups, one rarely present in the median group, three to six in the anterolateral and posterolateral groups each.

Specimens examined. Chia-i, on *Coccoloba uvifera*; Kuan-tzu-ling, on *Machilus kusanoi*.

Distribution and host plants. This species is widely distributed in the tropics and other warm parts of the world and occurs commonly within doors in the temperate region, feeding on various kinds of plants. Takahashi recorded it in Taiwan on the following plants: *Camellia japonica*, *C. sinensis*, *Celtis sinensis*, *Cocos nucifera*, *Gardenia* sp., *Maesa* sp., *Mangifera indica* and *Psychotria serpens*.

34. ***Hemiberlesia pityophila***, n. sp. [Fig. 24; 32 A]

Diagnosis. Body broadly pyriform, with the second to fourth abdominal segments lobed out laterally, and with the pygidium quite broad. Derm remaining membraneous except for the pygidium, with scaly granulations just posteriorly to the mouth-parts. Median lobes robust, slightly asymmetric, flatly rounded apically, deeply notched on each side, separated from each other by about one-third the width of one of them, and set practically parallel; the base of each lobe ontruding into the pygidium in a robust sclerotized area. Second lobes convergent, quite small, and sclerotized. Third lobes obsolete. Plates little fimbriate, slender, two between the median lobes small and not extending beyond the lobes, two between the median and second lobes, three between the second lobe and the expected position of the third lobe, and three or so laterally to this position. Dorsal macroducts of the pygidium long and slender, one between the median lobes extending far beyond the anal opening, others are arranged in three single rows on each side of the pygidium as follows: two or three between the median and second lobes (between the seventh and eighth abdominal segments)

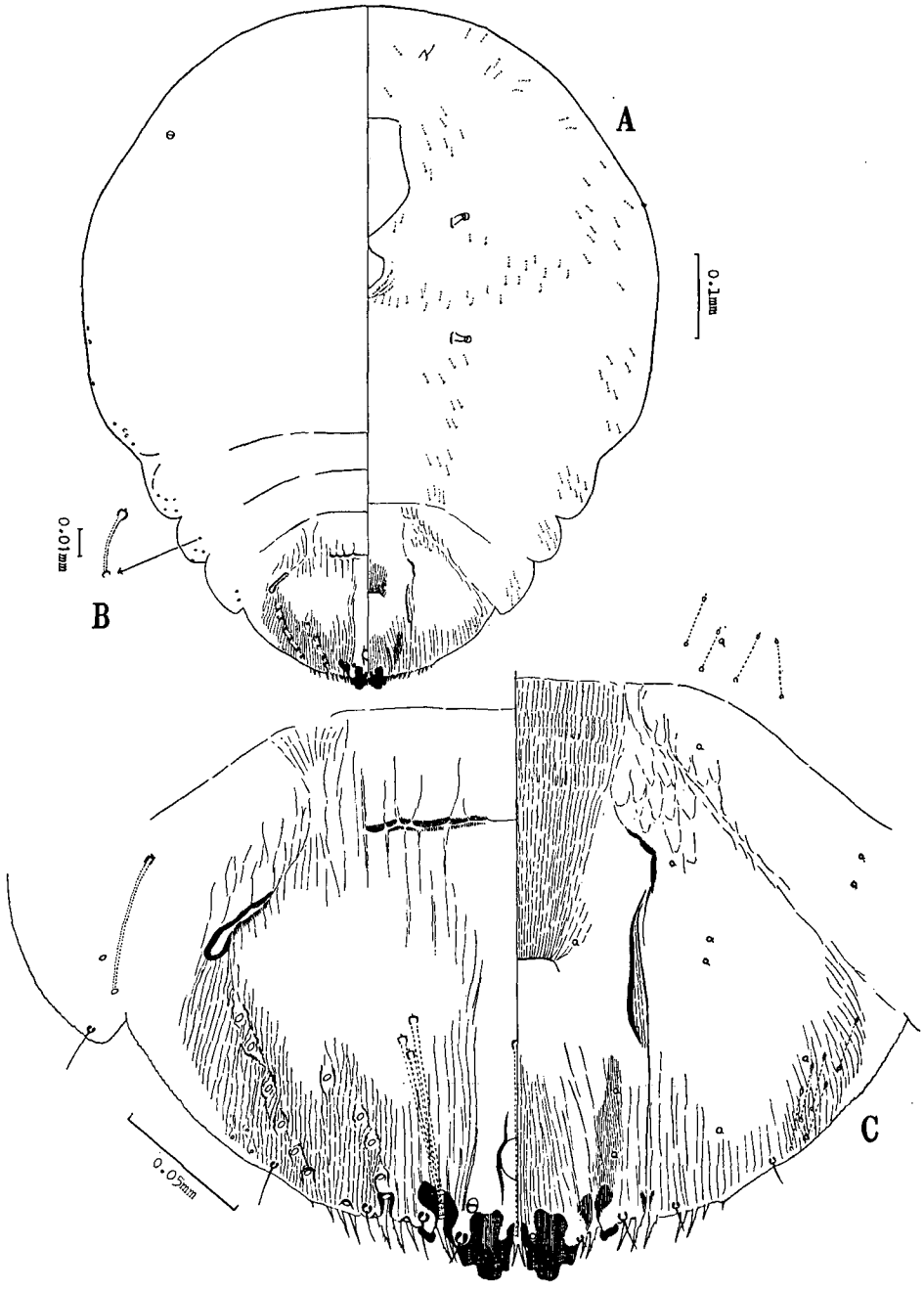

Fig. 24. *Hemiberlesia pitysophila*, n. sp. Adult female (A, body; B, prepygidial dorsal duct; C, pygidium).

enclosed by a pair of marginal scleroses, four to eight in the next row (between the sixth and seventh abdominal segments), with the posteriormost one or two enclosed by a pair of rather rudimentary marginal scleroses, and five to seven in the outermost row (between the fifth and sixth abdominal segments), this last row extending anteriorly towards the laterobasal sclerosis of the pygidium. Two to four similar submarginal dorsal macroducts on the fourth abdominal segment. Much shorter macroducts along the margin of the prepygidial region: two or three on the thorax and the basal abdominal segment each, and two to four on the succeeding two segments each. Ventral microducts strewn in the following regions: in front of the anterior spiracles; in a transverse row between the anterior and posterior spiracles; in the rear of the posterior spiracles; in the submedian region of the prepygidial abdominal segments; on the lateral lobes of the second to fourth abdominal segments; and towards the laterobasal corners of the pygidium. Antennae irregularly conical, each with a seta. Prosomatic tubercles quite minute, sclerotized. Spiracles each with a patch of minute derm granulations. Anal opening rounded, rather small, as long as the median lobe in its longitudinal diameter (the length of the median lobe is measured on the produced part of the lobe), removed from the bases of the median lobes by about this diameter. Mediobasal, laterobasal and paravulvar scleroses of the pygidium strongly sclerotized. Perivulvar pores absent. Scale white.

Specimens examined. Yang-ming Shan and southeastern Tai-pei Hsien, on the needles of *Pinus* spp.

Remarks. This species is close to *makii* Kuwana (=*Diaspidiotus makii*) from Japan, Ryukyu and Korea and *momicola* Takagi and Kawai (=*Abgrallaspis momicola*) from Japan, all being conifer-feeding species. It is distinguished from *makii* mainly by the second lobes sclerotized and the plates present laterally to the position of the third lobe. It differs from *momicola* mainly by the third lobes absent, the dorsal macroducts of the pygidium arranged exclusively in three intersegmental rows on each side, and the fourth abdominal segment having submarginal dorsal macroducts.

XIV. Genus ***Aonidiella*** Berlese and Leonardi

References. Berlese *1895 b*: 77; McKenzie *1938*; Ferris *1938 a*: 178; Balachowsky *1948 b*: 359; ibid. *1956*: 22.

Synonyms. *Heteraspis* Leonardi, 1914 [type-species: *Aspidiotus replicatus* Lindinger].

Type-species. *Aspidiotus aurantii* Maskell.

Diagnosis. Body peculiar in shape at maturity, the combined cephalothorax and the basal part of the abdomen being much enlarged in comparison with the remain of the body, produced on each side into a prominent lobe posteriorly, and heavily sclerotized, with the succeeding segments retracted into this enlarged region (in some species this combined region is much less enlarged, but sclerotized without exception). Pygidial lobes in three pairs all well developed, parallel, and similar in shape (in certain African species studied by Balachowsky the pygidial lobes are in two pairs); fourth lobe in an angular, sclerotized prominence or obsolete. Plates well developed and fimbriate in most species. Short marginal scleroses present on the pygidium, absent beyond the third lobes, in some species reduced. Dorsal macroducts long, with the orifice transversely elliptical; submarginal macroducts arranged in intersegmental rows, few in the row between the seventh and eighth abdominal segments. Antennae each with a seta.

Spiracles without disc pores. Anal opening small, situated towards the apex of the pygidium. Perivulvar pores present or absent.

Composition and distribution. So far as revised by McKenzie and, later, by Balachowsky, this genus is composed of more than 20 species concentrated in the Oriental region and in Africa south of Sahara. It largely coincides with *Aspidiotus* and *Lindingaspis* in the distributional pattern.

Remarks. So far as I am aware, the following five species of the genus were recorded from Taiwan: *aurantii*, *comperei*, *inornata*, *messengeri* and *taxus*. In the present collection I have found four species belonging to the genus; *aurantii*, *citrina*, *inornata* and a new species.

35. ***Aonidiella aurantii*** (Maskell) [Fig. 32 B]

References. Maskell *1879*: 199 [*Aspidiotus*]; McKenzie *1938*: 6; Ferris *1938 a*: 179; Balachowsky *1948 b*: 366; ibid. *1956*: 30.

Synonyms. *Aspidiotus citri* Comstock, 1881; *Aspidiotus coccineus* Gennadius, 1881; *Aonidiella gennadii* Targioni, 1881.

Diagnosis. Body typical of the genus in shape at maturity. Second and third lobes evidently smaller than the median. Three plates between the third and fourth lobes; no plate laterally to the fourth lobe. One macroduct between the median lobes extending far beyond the anal opening; four between the seventh and eighth abdominal segments (between the median and second lobes); eight to 12 in a row between the sixth and seventh abdominal segments; two marginal macroducts between the third and fourth lobes, the outer of them leading to a row of four to seven submarginal macroducts between the fifth and sixth abdominal segments; and one near the margin laterally to the fourth lobe. Three ventral sclerotized spots (two prevulvar scleroses arranged transversely and a prevulvar apophysis just posteriorly) present in the base of the pygidium on each side near the middle line. Anal opening shorter than the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about three to four times this diameter. Perivulvar pores absent.

Specimens examined. Chu-chi, on *Maesa tenera* and orange tree; Kuan-tzu-ling, on orange tree.

Distribution and host plants. This species is a well-known pest of orange and lemon and known to occur on other various kinds of plants in the tropics and other warm parts of the world. It is, however, possible that the records of this species from coniferous trees are erroneous and should in reality be referred to the other distinct species *taxus*. Takahashi recorded various plants as hosts of *aurantii* in Taiwan, but his records of this species on the coniferous plants *Pinus thunbergii* and *Podocarpus macrophyllus* may be referred to *taxus*. His records may also include other close species such as *citrina* and *inornata*.

36. ***Aonidiella citrina*** (Coquillett) [Fig. 32 C, D]

References. Coquillett 1891, U. S. Dept. Agr. Div. Ent. Bul. 23: 29 [*Aspidiotus*]; Nel *1933*; McKenzie *1938*: 7; Ferris *1938 a*: 179; Balachowsky *1956*: 34.

Diagnosis. Body typical of the genus in shape at maturity. Second and third lobes practically as large as or a little smaller than the median. Three plates between the third and fourth lobes; no plate laterally to the fourth lobe. Marginal scleroses of the pygidium tending to be reduced. One macroduct between the median lobes,

extending far beyond the anal opening; four or five between the seventh and eighth abdominal segments (between the median and second lobes); eight to 12 in a partly irregularly double row between the sixth and seventh abdominal segments; two marginal macroducts between the third and fourth lobes, the outer of them leading to a row of five to nine submarginal macroducts, this row tending to be irregularly double; and one or two macroducts near the margin laterally to the fourth lobe. Only one ventral sclerotized spot (prevulvar aphophysis) present in the base of the pygidium on each side near the middle line (prevulvar scleroses absent). Anal opening about as long as the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about three times this diameter. Perivulvar pores absent.

Specimens examined. Yang-ming Shan, on *Cleyera japonica* var. *morii*, *Maesa tenera* and orange tree; Southeastern Tai-pei Hsien, on *Helicia formosana* and *Smilax* sp.; Kuan-tzu-ling, on *Ardisia sieboldii*; Fen-chi-hu, on *Livistona subglobosa* and *Smilax* sp.

Distribution and host plants. This species was originally described as an orange-feeder in California, and recently recorded there from various kinds of plants. Although its records of occurrence are rather few perhaps owing to failure to distinguish it from *aurantii*, it may very probably be widely distributed in the tropics and subtropics of the world mainly through the agency of man as in the case of *aurantii*.

Remarks. This species is very close to *aurantii*, and was included within the latter by authors. It was Nel (*1933*) who recognized it as a distinct species and not as a variety of *aurantii* with evidence based upon a comparative study in ecology, biology and morphology. Finally, it was found by McKenzie (*1937*) that the two are successfully separated by certain morphological details which are present in the base of the pygidium. It is, therefore, not surprising that this species was not recorded by Takahashi from Taiwan in spite of its common occurrence as concluded from the material at hand. His records of *aurantii* may possibly include *citrina*.

37. ***Aonidiella inornata*** (McKenzie) [Fig. 33 A]

References. McKenzie *1938*: 10.

Diagnosis. Body typical of the genus in shape at maturity. A series of square, membraneous parts of the derm (fenestrations) present just posteriorly to the posterior spiracles. Second and third lobes smaller than the median. Three plates between the third and fourth lobes; no plate laterally to the fourth lobe. Marginal scleroses of the pygidium tending to be reduced. One macroduct between the median lobes, extending beyond the anal opening; three or four between the seventh and eighth abdominal segments (between the median and second lobes); seven to nine in a row between the sixth and seventh abdominal segments; two marginal macroducts between the third and fourth lobes, the outer of them leading to a row of four to nine submarginal macroducts; and one near the margin laterally to the fourth lobe. No distinct sclerotized spots in the base of the pygidium. Anal opening about as long as the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about twice this diameter. Perivulvar pores absent.

Specimens examined. Heng-chun, on plam; Kuan-tzu-ling, on *Cycas* sp.

Distribution and host plants. This species was originally described from specimens collected in the Philippines, Hongkong and Hawaii on *Astronia* sp. and other various

plants, and later recorded in Taiwan on papaya and in Micronesia on *Cocos nucifera* and many other plants.

Remarks. In well-stained specimens there are apparently seen square membraneous parts or fenestrations on the derm just in front of the membraneous prepygidial region of the abdomen. In other characters the specimens at hand agree well with the original description.

28. ***Aonidiella tsugae***, n. sp. [Fig. 25]

Diagnosis. Body much less reniform than is typical for the genus, the combined cephalothorax and the basal part of the abdomen not stronlgy lobed out posteriorly,

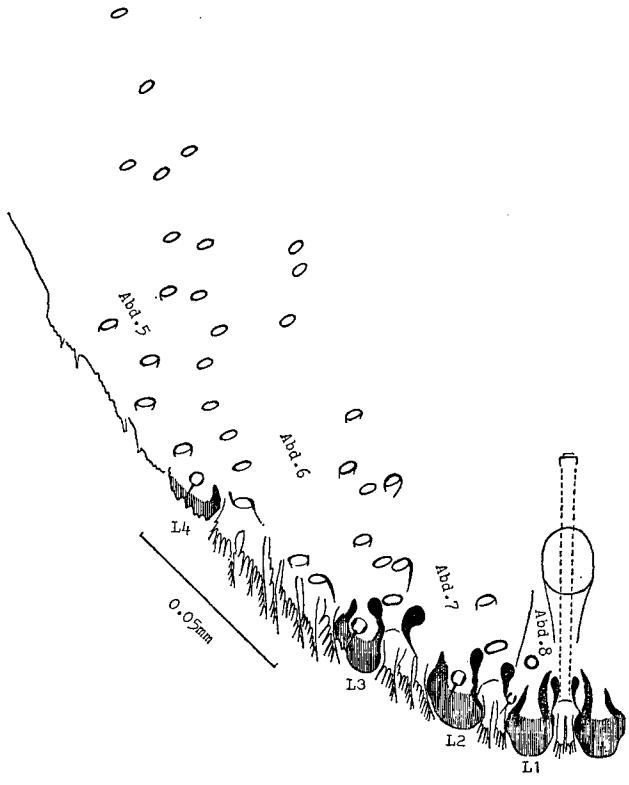

Fig. 25. *Aonidiella tsugae*, n. sp. Adult female (part of the pygidium in dorsal view).

yet heavily sclerotized. Pygidial lobes in three pairs, the fourth lobe reduced to a dentate sclerotized process. Median lobes as long as wide, rounded, practically entire, with a trace of a subapical notch on the outer side ; are separated from each other by a space about half as wide as one of them. Second lobes as large as the median, oblique on the outer margin. Third lobes a little smaller than the second, similar in shape to the latter, with two slight notches on the outer side. Plates well developed and all fimbriate ; two between the median lobes and also between the median and second lobes, three between the second and third lobes, and six between the third and fourth lobes. Marginal scleroses of the pygidium short, the one occurring midway

between the second and third lobes swollen anteriorly. One macroduct between the median lobes, extending beyond the anal opening; three or four between the seventh and eighth abdominal segments (between the median and second lobes); 12 in an irregularly double or triple row between the sixth and seventh abdominal segments; three or four marginal macroducts between the third and fourth lobes, the outermost of them leading to a row of 14 submarginal macroducts, this row tending to be irregularly double or triple anteriorly; four macroducts near the margin laterally to the fourth lobe; second to fourth abdominal segments each with a partly irregularly double or triple row of about 10 submarginal macroducts. Thoracic tubercles quite small, conical. No particular sclerotized spots in the base of the pygidium. Anal opening slightly longer than the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about 1.5 times this diameter. Perivulvar pores absent. Scale dark brown, rather nipple-like in shape.

Specimens examined. Tung-pu, on the leaf of *Tsuga chinensis* var. *formosana* [one adult female in poor condition].

Remarks. This species is related to *A. andersoni* Laing and *A. orientalis* (Newstead) by the body shape and by having dorsal macroducts on prepygidial segments. It is distinguishable from the latter two mainly by having six plates, all well fimbriate, between the third and fourth lobes, by the rows of dorsal macroducts tending to be double or triple between the fifth and sixth abdominal segments and between the sixth and seventh, and by lacking perivulvar pores (in comparison with *orientalis*). It differs from *A. abietina* Hall and Williams, which occurs on *Abies* in Pakistan, by the body less reniform, by lacking prevulvar apophyses, and by the anal opening close to the apex of the pygidium. It is quite distinct from *A. taxus* Leonardi, another conifer-feeding species, by the body shape, by the pygidial lobes, by the prepygidial dorsal macroducts, etc. The female scale of the new species is quite different in appearance from those of other species of the genus, and is similar in both shape and colour to that of *Tsugaspidiotus tsugae* (Marlatt).

XV. Genus ***Chrysomphalus*** Ashmead

References. Ashmead *1880*; Ferris *1938a*: 198; McKenzie *1939*; Balachowsky *1948b*: 345; ibid. *1956*: 82.

Type-species. *Chrysomphalus ficus* Ashmead.

Diagnosis. Body pyriform, with the pygidium produced. Derm remaining membraneous in the prepygidial region (except for *fodiens* Maskell, in which the prosomatic region is heavily sclerotized at maturity). Pygidial lobes in three pairs all well developed, the fourth lobes merged into sclerotized marginal serrations of the fifth abdominal segment. Plates well developed and fimbriate, absent laterally to the fourth lobes; three plates between the third and fourth lobes, each with one or two elongate processes. Marginal scleroses of the pygidium well developed and elongate; absent or, if present, tending to be reduced between the third and fourth lobes. Dorsal macroducts long, most of them being arranged in three intersegmental rows on each side of the pygidium, those in the outer two rows abundant in number and tending to be more slender. Anal opening close to the apex of the pygidium. Perivulvar pores present in the type-species.

Composition and distribution. This genus is composed of more than 10 species concentrated in the Oriental and Australian regions.

Remarks. This genus is close to *Aonidiella*, but easily distinguished from the latter by the cephalothorax and the basal part of the abdomen not combined into an enlarged, heavily sclerotized region, by the marginal scleroses of the pygidium well developed and elongate, and by the dorsal macroducts of the pygidium belonging to two different types concerning their size, those occurring laterally to the second lobes being more slender. In the last character this genus is related to *Lindingaspis*, but the difference in the size of the macroducts is less remarkable in *Chrysomphalus*.

So far as I am aware, the following species were recorded in *Chrysomphalus* from Taiwan:

1) *aonidum* L. Identical with *ficus*.
2) *aurantii* Maskell. Type-species of *Aonidiella*.
3) *bifasciculatus* Ferris.
4) *dictyospermi* Morgan. Not collected.
5) *ficus* Ashmead.
6) *rossi* Maskell. A species of *Lindingaspis*. Not collected.
7) *tayabanus* Cockerell. An assumed member of *Clavaspidiotus* Takagi and Kawai. Not collected.

39. ***Chrysomphalus ficus*** Ashmead

References. Ashmead *1880*; Ferris *1938 a*: 201; McKenzie *1939*: 59; Balachowsky *1948 b*: 346; ibid. *1956*: 88.

Synonyms. *Chrysomphalus aonidum* auct., partim.

Diagnosis. Median lobes as long as wide, with a deep notch on the outer side; are separated from each other by a space a little narrower than one of them. Second lobes practically as large as the median and similar in shape to the latter. Third lobes a little smaller, serrate on the oblique outer margin. Plates between the third and fourth lobes with two long processes which are little ensiform. One macroduct between the median lobes, extending far beyond the anal opening; three or four between the seventh and eighth abdominal segments (between the median and second lobes); 17 to 27 between the sixth and seventh abdominal segments and 17 to 22 between the fifth and sixth crowded in irregularly double or triple rows; one near the margin on the fifth abdominal segment. Second abdominal segment with a transverse submarginal cluster of six to 19 macroducts, which are noticeably shorter than the pygidial macroducts. Smaller macroducts along the margin on the thorax posteriorly to the thoracic tubercle and on the basal three abdominal segments, few in number. Thoracic tubercles pointed and sclerotized. Anal opening as long as the median lobe in its longitudinal diameter, removed from the bases of the median lobes by twice this diameter. Perivulvar pores in four groups, five to eight in the anterolateral group, and three to five in the posterolateral.

Specimens examined. Tai-pei and Heng-chun, on *Podocarpus* sp. (*P. macrophyllus*?).

Distribution and host plants. This species is widely distributed in the tropics and subtropics of the world, feeding on quite various kinds of plants. Takahashi recorded it in Taiwan on a long list of plants, but it is possible that his records include in reality the two distinct species *ficus* and *bifasciculatus*, which were confused in the past for a long time.

Remarks. I agree with Takahashi (*1929*: 81) in that this species feeds on some coniferous plants as well as on various non-coniferous plants. I have failed to find

morphological particulars to distinguish the present specimens which were all collected on the coniferous plant *Podocarpus*.

40. ***Chrysomphalus bifasciculatus*** Ferris

References. Ferris *1938 a*: 199; McKenzie *1939*: 57.

Synonyms. *Chrysomphalus aonidum* auct., partim.

Diagnosis. Median lobes as long as wide, with a deep notch on the outer side, and with a less distinct notch on the inner side; are separated from each other by a little less than the width of one of them. Second lobes as large as or a little smaller than the median, with a deep notch on the outer side. Third lobes smaller than the second, similar in shape to the latter. Plates between the third and fourth lobes with two long processes which are little ensiform. One macroduct between the median lobes, extending far beyond the anal opening; four to six between the seventh and eighth abdominal segments (between the median and second lobes); about 10 to 20 in a single or irregularly double or triple row between the sixth and seventh abdominal segments and also between the fifth and sixth; one near the margin laterally to the fourth lobe. Second and third abdominal segments each with a transverse submarginal cluster of about three to 10 macroducts, which are shorter than the pygidial macroducts. Smaller macroducts along the margin on the thorax posteriorly to the thoracic tubercle and on the basal three abdominal segments, quite few in number. Thoracic tubercles pointed and sclerotized. Anal opening as long as or a little longer than the median lobe in its longitudinal diameter, removed from the bases of the median lobes by 1.5 to 2.5 times this diameter. Perivulvar pores in four groups, two to seven in the anterolateral group, and three to five in the posterolateral.

Specimens examined. Southeastern Tai-pei Hsien, on *Dianiella ensifolia;* Heng-chun, on *Pandanus odoratissimus*.

Distribution and host plants. This species was originally described as a separation from *ficus* on the basis of specimens collected in California, China, Hawaii and Japan on *Aspidistra*, *Euonymus japonicus* and other plants. The published records of *aonidum* in Japan on various plants all refer to the present species. Authentic records of this species include a long list of plants as the hosts in California. Takahashi recorded this species in Taiwan on *Cycas* sp. and *Pandanus* sp.

Remarks. The specimens at hand from Tai-pei Hsien are somewhat different from those from Heng-chun by the dorsal macroducts less numerous and the anal opening larger in size and situated closer to the apex of the pygidium. There has been found no other distinct difference between the two forms.

XVI. Genus ***Lindingaspis*** MacGillivray

References. MacGillivray *1921*: 388; Ferris *1938 a*: 245; McKenzie *1950*: 98; Balachowsky *1951*: 589; ibid. *1958 b*: 163; Williams 1963, Brit. Mus. (Nat. Hist.) Ent. Bul. 15: 3.

Type-species. *Melanaspis samoana* Lindinger.

Diagnosis. The type-species is known only from the original description, and has been not yet revised by recent authors. On the basis of other species which are assumed to be congeneric with the type-species this genus may be defined as follows: Body pyriform, with the pygidium produced. Derm membraneous except for the pygidium; pygidium with the intersegmental furrows membraneous between the fifth and sixth abdominal

segments and between the sixth and seventh. Pygidial lobes in three pairs all similar in shape and size. Fourth lobe merged into the sclerotized margin, which extends in a series of low, broad, angular processes as far as the marginal seta of the fourth abdominal segment. Plates at most slightly exceeding the lobes, more or less broad, fimbriate apically, the apical fimbriation somewhat fleshy in appearance; one or two plates between the median lobes and also between the median and second, two or three between the second and third, three between the third and fourth, the outer two of them tending to be reduced into sclerotized marginal serrations. Marginal scleroses well developed, arising at the basal angles of the lobes, another sclerosis midway between the second and third lobes; a series of progressively diminishing-sized scleroses laterally to the third lobe, extending as far as the marginal seta of the fourth abdominal segment. Dorsal macroducts of the pygidium in two sizes: large-sized macroducts towards the apex of the pygidium; small-sized or filiform macroducts abundant in the intersegmental furrows between fifth and sixth abdominal segments and between the sixth and seventh, and also along the margin of the fifth abdominal segment. Anal opening in the centre of the pygidium. Perivulvar pores present or absent.

Composition and distribution. So far as revised by Williams this genus is composed of 24 described species centred in the Ethiopian, Oriental and Australian regions. A further species (*L. equipora* Munting) is known from South Africa. This genus largely coincides with *Aspidiotus* and *Aonidiella* in the distributional pattern.

41. ***Lindingaspis ferrisi*** McKenzie [Fig. 33 B]

References. McKenzie *1950*: 100.

Diagnosis. Pygidial lobes each with a deep notch on the outer side. One plate between the median lobes; one between the median and second lobes, at times appearing as divided into two plates; three between the second and third lobes, the outer two tending to be united together basally; one laterally to the third lobe, followed by two sclerotized processes which still retain some semblance of the plate. Marginal scleroses slender, those associated with the lobes apparently longer than the latter except the one arising at the inner basal angle of the second lobe; intermediate sclerosis between the second and third lobes also quite elongate. Large-sized macroducts as follows: one marginal macroduct between the median lobes, one marginal and one submarginal between the median and second lobes, two marginal between the second and third lobes, and one marginal just laterally to the third lobe. Filiform submedian dorsal macroducts towards the base of the pygidium, much shorter than the filiform submarginal macroducts: one or two in number just above, and one to three below, the basal scar. Prepygidial filiform ducts as far as the thoracic tubercle along the margin. Smaller ventral ducts (microducts) in two submarginal clusters in the prepygidial region of the abdomen (on the assumed second and third abdominal segments). Thoracic tubercle reduced to a sclerotized patch opposite the posterior spiracle where the body is broadest. Anal opening about twice as long as the median lobe in its longitudinal diameter. Perivulvar pores in four groups, six to nine in the anterolateral group, and three to six in the posterolateral.

Specimens examined. Heng-chun, on *Callophyllum inophyllum*.

Distribution and host plants. This species was originally described from specimens collected in China on *Citrus* and other plants. Williams recorded it from India and

Taiwan.

Remarks. Part of the present material were sent to Prof. McKenzie and identified with this species by him. His letter reads: "This species appears to be quite stabilized with regards to morphological characteristics. Your specimens agreed in detail with the type material".

XVII. Genus ***Crassaspidiotus***, n. g.

Type-species. *Crassaspidiotus takahashii*, n. sp.

Diagnosis. Body pyriform, with the pygidium produced. Derm sclerotized throughout the body, without membraneous intersegmental furrows on the pygidial dorsum. Pygidial lobes in three pairs all well developed, parallel to the longitudinal axis of the body, and of about the same shape and size. Plates well developed; interlobar plates slender, fimbriate apically; plates occurring laterally to the third lobe (on the fifth and sixth abdominal segments) broader, fimbriate on the oblique outer margin, without any particularly elongate or clavate processes. Marginal setae of the pygidium normal. Dorsal macroducts of the pygidium slender, with the orifice elliptical; submarginal macroducts forming three long, a little oblique rows on each side of the pygidium, numerous in the mesalmost row as well as in the lateral two. Antennae small, widely separated from each other, each with a seta. Spiracles without disc pores. Anal opening towards the centre of the pygidium. Perivulvar pores present.

Composition and distribution. This genus is erected for the following new species from Taiwan.

Remarks. This genus is characterized by the derm sclerotized throughout, the pygidial lobes all of about the same shape and size, the submarginal dorsal macroducts numerous in three rows on each side of the pygidium, the anal opening situated towards the centre of the pygidium, etc. This genus may be close to *Metaspidiotus*, from which it is easily distinguishable by the marginal setae of the pygidium all normal in shape, none of them being thickened and lanceolate.

42. ***Crassaspidiotus takahashii***, n. sp. [Fig. 26; 33 C]

Diagnosis. Dorsal intersegmental furrows strongly sclerotized between the meso- and metathorax, between the metathorax and abdomen, and between the pygidial and prepygidial regions; three similar furrows are also seen on the supposed basal two abdominal segments, dividing this area into four segment-like divisions. Derm with many small sclerotized patches in the prepygidial region. Pygidium rounded apically. Median lobes about as long as wide, somewhat dilated towards the apex, rounded apically, separated from each other by less than a half width of one of them. Second lobes practically same with the median in shape and size. Third lobes somewhat wider, with the apical margin slanting outwards. Two plates between the median lobes, two between the median and second, and two or three between the second and third; eight or nine plates laterally to the third lobe (on the fifth and sixth abdominal segments). One macroduct between the median lobes, two-thirds as long as the distance between the anal opening and the bases of the median lobes; seven to 12 in the mesalmost row, which arises between the median and second lobes (between the seventh and eighth abdominal segments) and extends to the level of the anal opening; 10 to 16 in the next row (between the sixth and seventh segments); eight to 11 in the outermost row (be-

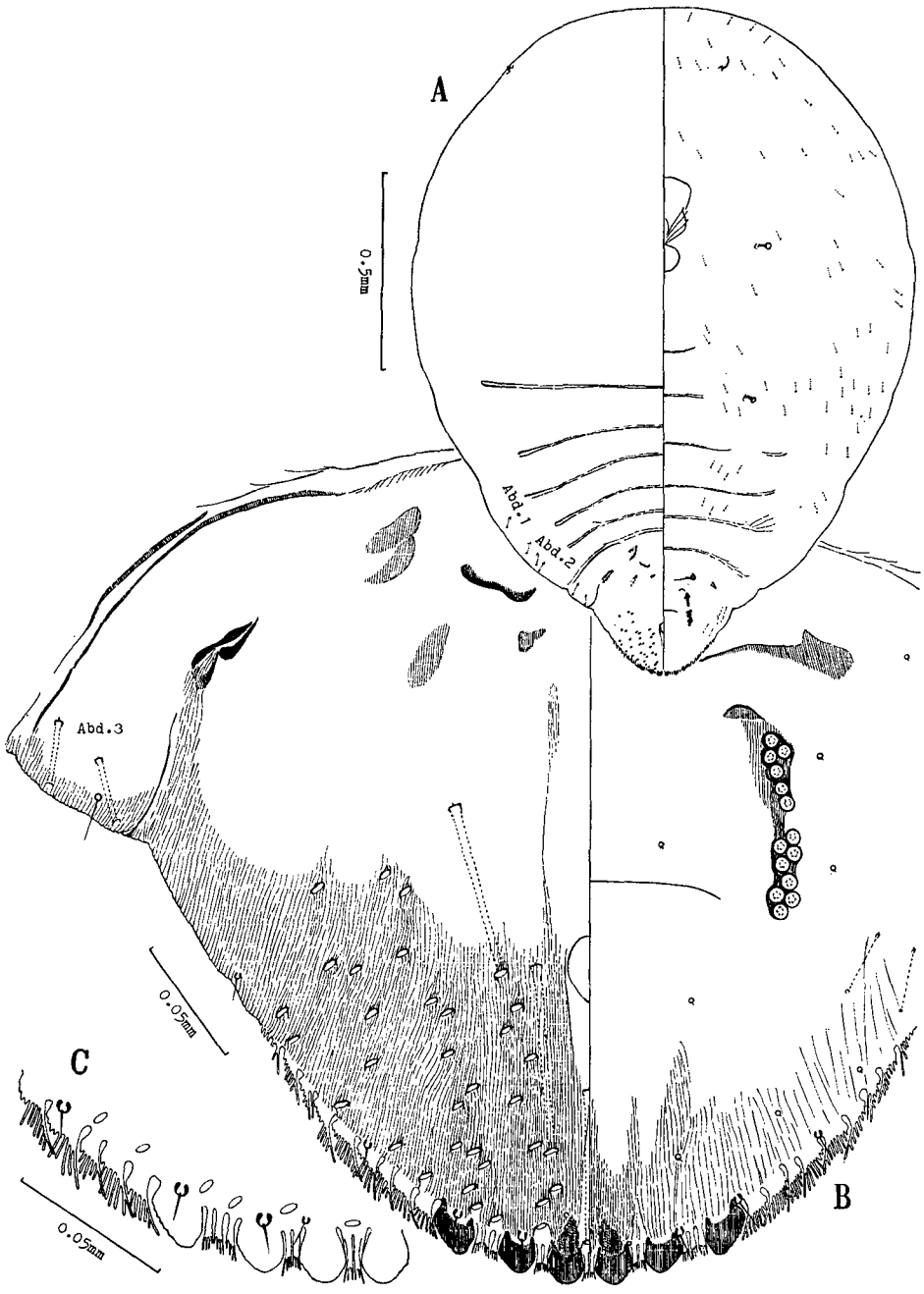

Fig. 26. *Crassaspidiotus takahashii*, n. sp. Adult female (A, body ; B, pygidium ; C, pygidial margin).

tween the fifth and sixth segments); and two or three along the margin on the fifth segment. A few shorter macroducts along the margin on the first to third abdominal segments each. Thoracic tubercles quite small. Anal opening longer than the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about four times this diameter. Perivulvar pores usually in four groups, four to seven in the anterolateral group, and two to nine in the posterolateral, these groups being at times continuous on each side of the pygidium; median group rarely indicated by a single disc pore much removed laterally from the middle line. Scale elliptical, moderately convex dorsally, thin, and pale brownish in colour.

Specimens examined. Tung-pu, on the leaves of *Tsuga chinensis* var. *formosana*.

Remarks. At first sight this species reminds me of *Metaspidiotus stauntoniae* owing to the segmentation of the thickly sclerotized body and other characters. This species may in reality be closely related with the species of *Metaspidiotus*, but can not be referred to that genus as defined herein on account of the marginal setae of the pygidium all not lanceolate.

XVIII. Genus ***Metaspidiotus*** Takagi

References. Takagi *1957*: 35.

Type-species. *Aspidiotus stauntoniae* Takahashi.

Diagnosis. Body pyriform, with the pygidium produced. Derm strongly sclerotized throughout at maturity in the type-species. Pygidial lobes in three pairs all well developed, parallel or a little divergent to the longitudinal axis of the body. Second and third lobes each with an eminently thickened and lanceolate seta on the dorsal base. Plates well developed and fimbriate; those occurring laterally to the third lobe broad, with processes somewhat of a fleshy appearance. Dorsal macroducts of the pygidium long, with the orifice transversely elliptical; submarginal macroducts forming three rows on each side of the pygidium, numerous in the mesalmost row as well as in the lateral two. Anal opening towards the centre of the pygidium. Perivulvar pores present normally in four groups in the type-species.

Composition and distribution. The type-species occurs in Japan, Ryukyu and Taiwan, *M. multipori* Takahashi in Japan, and *M. machili* Takahashi in Taiwan. *Aspidiotus calophylli* Green from Ceylon seems to be close to the type-species.

Remarks. This genus was erected as a separation from *Aspidiotus*, but may in reality be not so close to the latter. So far as based on the arrangement of the dorsal macroducts and other characters this genus may form a close group together with *Crassaspidiotus* and *Selenomphalus*, all being confined to eastern Asia in distribution. Among these genera it is peculiarly characterized by the lanceolate marginal setae of the pygidium. Such thickened marginal setae are also found in *Unaspidiotus* MacGillivray and *Acanthaspidiotus* Borchsenius and Williams, which appear, however, to be remote from *Metaspidiotus* by the characters of the pygidial fringe, dorsal macroducts and anal opening.

43. ***Metaspidiotus stauntoniae*** (Takahashi) [Fig. 33 D]

References. Takahashi *1933*: 54 [*Aspidiotus*]; Takagi *1957*: 36.

Diagnosis. Body, when fully matured, thickly sclerotized throughout, with the dorsal intersegmental furrows strongly sclerotized between the thorax and abdomen

and between the pygidial and prepygidial regions across the whole breadth of the body; furrow between the meso- and metathorax also strongly sclerotized, but not reaching the body margin; three similar furrows present on the supposed basal two abdominal segments, dividing this area into four segment-like divisions for most breadth of the body. Lanceolate setae on the second and third lobes scarcely or a little extending beyond the apices of these lobes. Dorsal macroducts of the pygidium thickly sclerotized for a short length just within the orifice at maturity. One marginal macroduct between the median lobes, attaining about the posterior two-thirds of the distance between the anal opening and the bases of the median lobes, one between the median and second lobes, two between the second and third lobes, two between the third lobe and the dorsal marginal seta of the fifth abdominal segment, and one laterally to this seta. Twenty-seven to 35 submarginal macroducts on each side of the pygidium as follows: five to seven in the mesalmost row (between the seventh and eighth abdominal segments), nine to 11 in the next row (between the sixth and seventh abdominal segments), and 14 to 19 in the outermost row (between the fifth and sixth abdominal segments). Some much smaller macroducts along the margin of the first to third abdominal segments. Perivulvar pores normally in four groups, the median group rarely present, with a single disc pore; two to four disc pores in the anterolateral group, and three to six in the posterolateral.

Specimens examined. Heng-chun, on *Hibiscus tiliaceus.*

Distribution and host plants. This species was originally described from Taiwan as a feeder of *Stauntonia hexaphylla* and later recorded by the original author from the following plants in Taiwan under the name *Aspidiotus transparens*: *Eurya* sp., *Ficus* sp., *F. foveolata*, *Maesa* sp., *Scolopia oldhamii* and *Vitis* sp. It was later recorded in Ryukyu on *Citrus depressa* and in Japan on *Elaeagnus pungens*, *Fatsia japonica* and *Hedera rhombea.*

Remarks. This species is easily recognizable in the maturity of the adult female by the body wholly and thickly sclerotized, by the characteristic segmentation of the body, and by the dorsal macroducts thickly sclerotized just within the orifice. When the adult female is young and immature, these particulars do not make their appearance, yet this species may still be distinguishable from the other species of the genus by the lanceolate setae of the pygidium extending scarcely or a little beyond the apices of the second and third lobes and by the perivulvar pores fewer.

44. ***Metaspidiotus machili*** (Takahashi) [Fig. 27 A, B]

References. Takahashi *1931 b*: 384 [*Aspidiotus*].

Diagnosis. Derm remaining membraneous except for the pygidium. Pygidial lobes practically parallel or a little divergent to the longitudinal axis of the body. Median lobes robust, about as long as wide, flatly rounded apically, deeply notched once on each side, and separated from each other by a space a little narrower than one of them, with an ill-defined sclerotized area on the base of each. Second and third lobes much smaller, yet well developed, deeply notched on the outer side. Eight or nine plates well developed laterally to the third lobe. Lanceolate setae on the second and third lobes extending beyond the apices of these lobes. One marginal macroduct between the median lobes, attaining about the posterior two-thirds of the distance between the anal opening and the bases of the median lobes, one between the median and second lobes, two between the second and third lobes, and two between the third lobe and

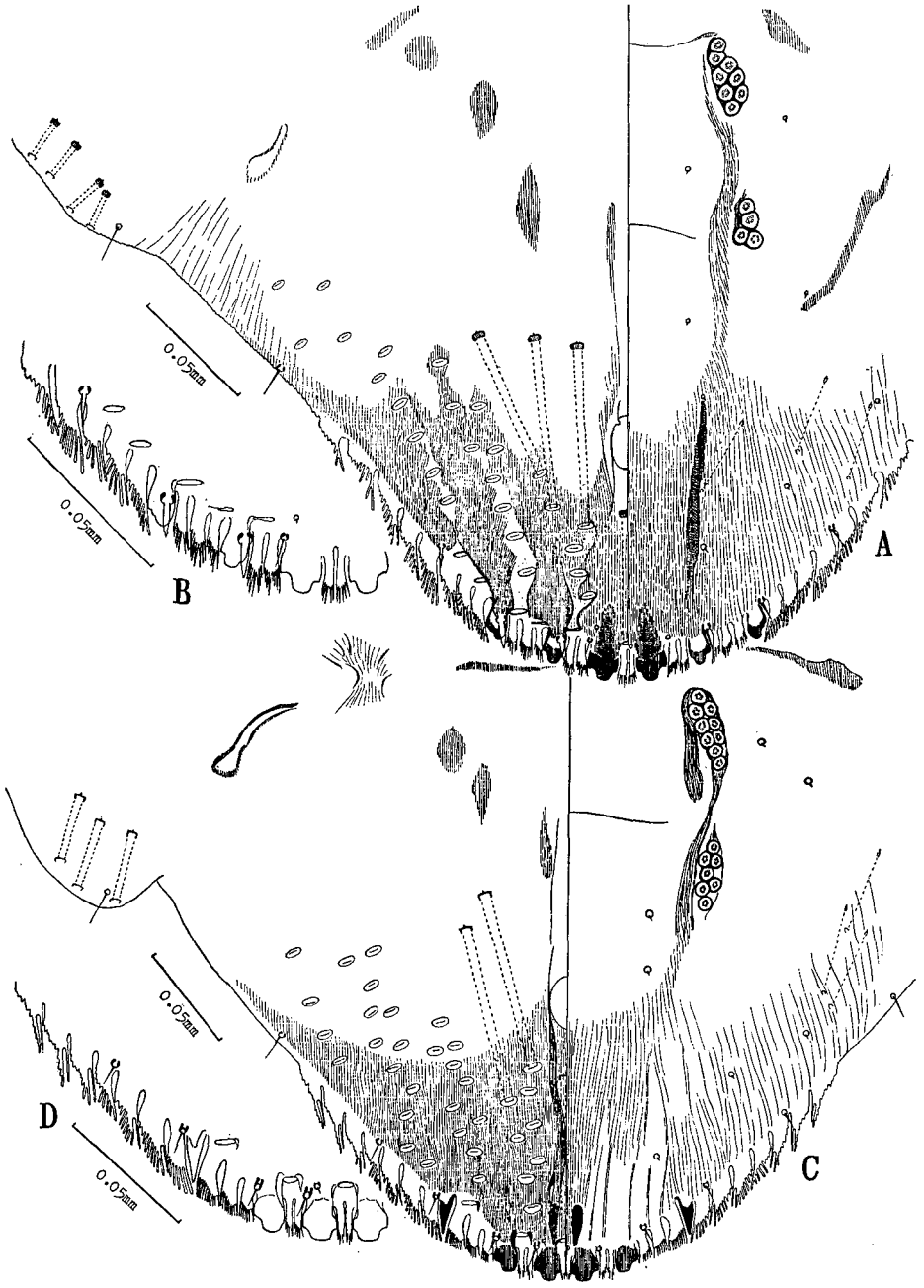

Fig. 27. A–D, adult females (A & C, pygidium ; B & D, pygidial margin). A & B, *Metaspidiotus machili* (Takah.); C & D, *Selenomphalus euryae* (Takah.).

the dorsal marginal seta of the fifth abdominal segment. Nineteen to 24 submarginal macroducts on each side of the pygidium as follows: four to six in the mesalmost row (between the seventh and eighth abdominal segments), eight or nine in the next row (between the sixth and seventh abdominal segments), and six to 10 in the outermost row (between the fifth and sixth abdominal segments). Prepygidial region of the abdomen with 12 to 21 much smaller macroducts marginally. Anal opening more or less longer than the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about thrice this diameter. Perivulvar pores normally in four groups, the median group rarely present and represented by one or two disc pores; five to 10 disc pores in the anterolateral group, and three to eight in the posterolateral.

Specimens examined. Southeastern Tai-pei Hsien, on *Schefflera octophylla*.

Distribution and host plants. This species was originally described from specimens collected in Taiwan on *Machilus* sp. So far as I am aware, there has been published no further record of this species.

Remarks. The specimens at hand disagree with the original description by having a lanceolate seta on the second lobe as well as on the third lobe. In the other characters, however, they fairly agree with the description, so that I have little doubt about the present identification. This species differs from *stauntoniae* by the derm of the prepygidial body remaining membraneous (in consequence, the segmentation is not strongly defined at maturity); by the dorsal macroducts of the pygidium not sclerotized just within the orifice at maturity; by the lanceolate setae extending beyond the apices of the second and third lobes; by the perivulvar pores more numerous in the anterolateral group; and by the submarginal macroducts of the pygidium slightly less numerous. It differs from *multipori* by the submarginal macroducts and the perivulvar pores less numerous.

XIX. Genus ***Selenomphalus*** Mamet

References. Mamet *1958 a*: 426.

Type-species. *Aspidiotus euryae* Takahashi.

Diagnosis. Body pyriform, with the pygidium produced. Derm remaining membraneous in the prepygidial region, the pygidium without membraneous intersegmental furrows on the dorsum. Pygidial lobes in three pairs, all well developed, the third lobes spur-like in shape, being narrowly conical in outline, and strongly sclerotized. Plates well developed and fimbriate, those occurring laterally to the third lobe without any particularly elongate or clavate processes. Dorsal macroducts of the pygidium long, with the orifice transversely elliptical and comparatively large. One marginal macroduct in each interlobar space of the pygidium. Submarginal macroducts in three or four rows on each side of the pygidium, numerous in the mesal three rows. Anal opening towards the centre of the pygidium. Perivulvar pores in four groups.

Composition and distribution. The type-species is known to occur in Taiwan and China. Another known species, *distylii* Takagi, occurs in Japan.

Remarks. In the arrangement of the dorsal macroducts and other characters this genus is related with *Metaspidiotus* and *Crassaspidiotus*, but is readily distinguished from the latter two by the spur-like third lobes. By the way, this genus was referred to his "*Selenaspidus*-complex" by Mamet owing to the shape of the third lobes.

45. ***Selenomphalus euryae*** (Takahashi) [Fig. 27 C, D; 34 A]

References. Takahashi *1931 b*: 383 [*Aspidiotus*]; Mamet *1958 a*: 428.

Diagnosis. Pygidium produced, approximately triangular in outline, and apically roundish. Median lobes about as long as wide, a little constricted basally, and flatly rounded apically, with a distinct subapical notch on each side; are separated from each other by a space a little narrower than one of them. Second lobes similar to the median in shape and size, but the subapical notch on the inner side less distinct and often practically obsolete. A pair of well-developed, fusiform scleroses at the inner bases of the median lobes. One marginal macroduct between the median lobes, a little or scarcely shorter than the distance between the anal opening and the bases of the median lobes, one between the median and second lobes, and one mesally to the third lobe. Twenty-eight to 41 submarginal macroducts on each side of the pygidium as follows: seven to 11 in the mesalmost row (between the seventh and eighth abdominal segments), this row attaining the level of the anal opening; nine to 14 between the sixth and seventh abdominal segments; eight to 13 between the fifth and sixth abdominal segments, two of them being almost marginal in position; and one to four in the outermost row. Much smaller macroducts along the margin on the prepygidial abdominal segments as follows: present or absent, if present one or two in number on the first abdominal segment; and three to five on the second and third each. Anal opening about twice as long as the median lobe in its longitudinal diameter, removed from the bases of the median lobes by about thrice this diameter. Perivulvar pores in four groups, six to 11 in the anterolateral group, and four to seven in the posterolateral group.

Specimens examined. Yang-ming Shan, on *Eurya japonica*; southeastern Tai-pei Hsien, on *Camellia sinensis*, *Eurya japonica* and *Gordonia axillaris*.

Distribution and host plants. This species was originally described from Taiwan as a feeder of *Eurya*. Mamet redescribed it on the basis of a specimen collected in China on *Loranthus parasiticus*. It should be noted that the plants on which the specimens at hand were collected all belong to the family Theaceae.

Remarks. The specimens at hand disagree with the original description in that the pygidium is more acute and in that the prepygidial macroducts are present not only on the third abdominal segment ("last abdominal segment") but also on the second and sometimes also the first segment. I have, however, little doubt about the correct identification of the specimens on account of their agreement with the original description in other characters and also of the agreement in host plants.

XX. Genus ***Diaonidia*** Takahashi

References. Takahashi *1956 b*: 25.

Type-species. *Aonidia yabunikkei* Kuwana.

Diagnosis. Pupillarial. Prepygidial region enlarged into a rounded, membraneous mass. Pygidium comparatively small, abruptly protruding in a triangle, slightly sclerotized, with three pairs of lobes all well developed and sclerotized. Plates well developed in the interlobar spaces and laterally to the third lobes, elongate, tending to be not fimbriate. Dorsal ducts of the pygidium quite reduced in size, filiform, with the orifice comparatively large and rounded; are quite few in number and confined within the

marginal area. Anal opening comparatively large, rounded, situated at the centre of the pygidium. Perivulvar pores absent.

Second instar female (exuvium) rounded, with the pygidium small, broad and slightly produced. Pygidial lobes in three pairs all well developed. Plates well developed. Dorsal ducts not reduced in size.

Composition and distribution. The type-species occurs in Japan and Ryukyu, and another form (*cinnamomi*), which is very close to the type-species, in Taiwan.

Remarks. This genus is very close to *Aonidia* Targioni, but so far as the type-species are concerned it may tentatively be separated from the latter by the lobes and plates well developed. In both genera the adult females are more or less modified owing to the pupillarial condition, yet the second instar females show an undoubted affinity of these genera with some typical aspidiotines (*Aspidiotus* and others).

46. ***Diaonidia cinnamomi*** (Takahashi) [Fig. 28 ; 34 B]

References. Takahashi *1936* : 82 [*Gymnaspis*].

Diagnosis. Median lobes a little longer than wide, flatly rounded apically, with a deep subapical notch on the inner side, and with two deep notches on the outer side ; are separated from each other by a little less than the width of one of them. Second lobes practically as large as the median lobes, with about three notches on the oblique outer margin. Third lobes similar in shape to the second, but smaller. Plates exceeding the lobes in length and little fimbriate ; a pair of quite slender plates in each interlobar space ; another pair of broader plates between the third lobe and the dorsal marginal seta of the fifth abdominal segment, these plates little narrowing towards the apex and scarcely fimbriate apically ; one or two plates on the supposed fifth abdominal segment, broad basally, gradually narrowing towards the apex. One marginal and two submarginal macroducts between the median and second lobes (between the seventh and eighth abdominal segments) ; one marginal just mesally to the third lobe ; and two or three macroducts scattered along the margin on the supposed sixth abdominal segment. Ventral microducts along the margin of the prepygidial region, each opened in a minute process.

Second instar female with the mesal three pairs of lobes well developed, longer than wide, and notched on the outer side ; median lobes separated from each other by a little less than the width of one of them. Fourth and fifth lobes each reduced to a low, angular, serrate, sclerotized process. Plates scarcely exceeding the mesal three pairs of lobes, fimbriate, occurring anteriorly as far as the fourth abdominal segment. One macroduct between the median and second lobes, between the second and third, and also between the third and fourth, and two between the fourth and fifth, the mesal two or three of the marginal macroducts broader than the others. One submarginal macroduct between the seventh and eighth abdominal segments (between the median and second lobes) and also between the sixth and seventh.

Specimens examined. Ken-ting, on *Machilus kusanoi* [three adult females with exuvia].

Distribution and host plants. This species was originally described from specimens collected in Taiwan on *Cinnamomum* sp. So far as I am aware, there has been made no further record.

Remarks. This species is so close to *yabunikkei* that it is open to question whether

the two are distinct. However that may be, the two are distinguishable by the plates as follows: the median pair are a little produced beyond the apices of the median lobes in *cinnamomi*, whereas scarcely in *yabunikkei*; two plates are present between the second and third lobes in *cinnamomi*, whereas usually three in *yabunikkei*; two or rarely three plates are present between the third lobe and the dorsal marginal seta of the fifth abdominal segment, little narrowing towards the apex, in *cinnamomi*, whereas

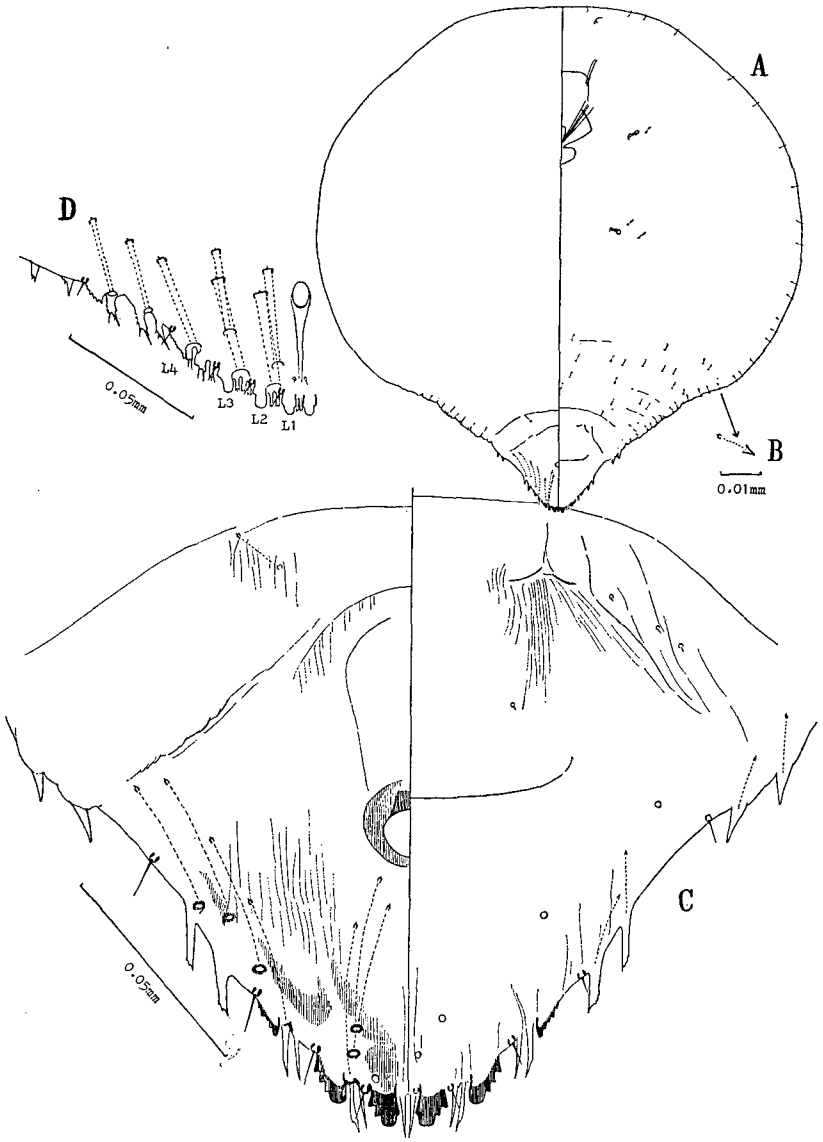

Fig. 28. *Diaonidia cinnamomi* (Takah.). A–C, adult female (A, body; B, marginal microduct of the prepygidial region; C, pygidium); D, exuvium of the second instar female (pygidial margin in dorsal view).

three plates in this space, narrowing towards the apex, in *yabunikkei*; and one or two plates are present on the fifth abdominal segment in *cinnamomi*, whereas none in *yabunikkei*. Furthermore, Takahashi distinguished this species from *yabunikkei* by the "shorter lobes", but it is difficult to separate the two by the pygidial lobes.

XXI. Genus ***Pseudaonidia*** Cockerell

References. Cockerell *1897 i*: 14; Ferris *1938 a*: 252; Balachowsky *1951*: 680; ibid. *1958 b*: 268.

Synonyms. *Pseudaonidiella* MacGillivray, 1921 [type-species: *Aspidiotus duplex* var. *paeoniae* Cockerell].

Type-species. *Aspidiotus duplex* Cockerell.

Diagnosis Body ovoid, with a deep constriction between the pro- and mesothorax, and with the lateral lobes of the third and fourth abdominal segments angulated posteriorly. Derm remaining membraneous in the prepygidial region or becoming sclerotized throughout, the pygidial dorsum elaborately areolated in the central region. Pygidial lobes in three or four pairs all parallel to the longitudinal axis of the body, the median lobes largest, the lateral lobes similar in shape and size to each other. Plates well developed, about as long as the lobes, terminated in rather fleshy processes, absent laterally to the fourth lobe (on the fifth abdominal segment). Marginal scleroses represented by sclerotized points in the type-species. Dorsal macroducts slender, with the orifice comparatively large and surrounded by a sclerotized rim; submarginal macroducts in segmental rows or bands on the whole segments of the abdomen; median and submedian macroducts absent. Anterior spiracles with disc pores. Anal opening comparatively small, situated posteriorly to the centre of the pygidium. Perivulvar pores present in the type-species.

Composition and distribution. Many species were referred to *Pseudaonidia* and not all of them have been revised by recent authors. So far as based on some revised and well-established species this genus seems to be mainly Afro-Asiatic in distribution.

Remarks. So far as I am aware, two species of the genus, *duplex* Cockerell and *trilobitiformis* Green, were recorded from Taiwan. In the present collection is found the following species.

47. ***Pseudaonidia trilobitiformis*** (Green) [Fig. 34 C]

References. Green *1896 e*: 41 [*Aspidiotus*]; Balachowsky *1951*: 684; ibid. *1958 b*: 272.

Synonyms. *Aspidiotus darutyi* de Charmoy, 1898.

Diagnosis. Pygidium rather trapezoid-like in outline, the apical margin being little rounded. Derm heavily sclerotized throughout at maturity. Pygidial lobes in four pairs. Median lobes a little longer than wide, with a subapical notch on either side; are separated from each other by a half width of one of them, and united basally through a thick sclerotization. Second lobes about as long as the median, extending slightly beyond the apices of the latter, but much narrower, and spatulate in shape, with a slight subapical notch on the outer side. Third and fourth lobes similar in shape to the second, progressively shorter. Pygidial margin irregularly crenulate laterally to the fourth lobe. Plates extending a little beyond the apices of the lobes, apically bifurcate into slender processes; two between the median lobes and also between the median and second, three between the second and third and also between third and fourth.

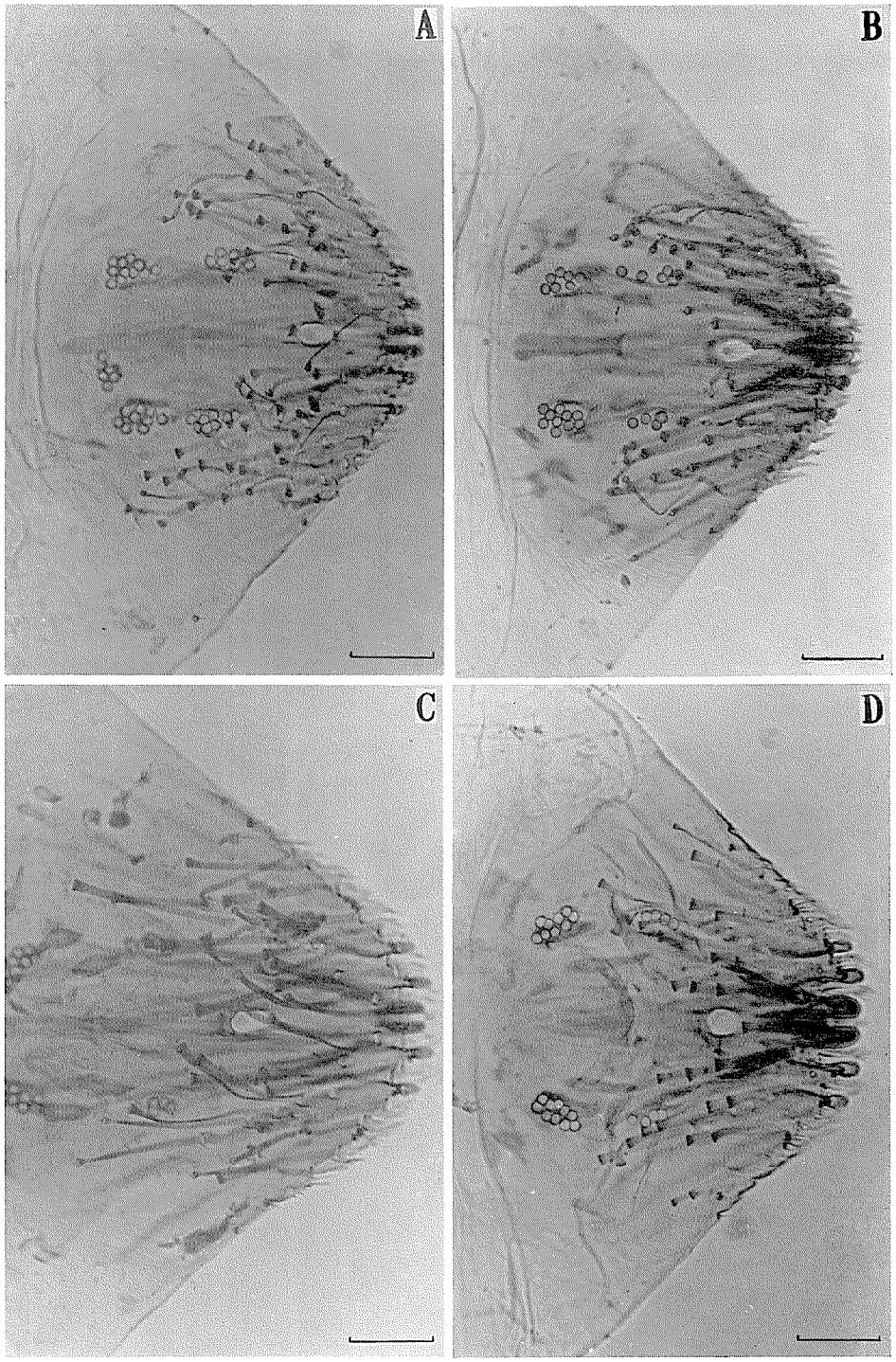

Fig. 29. A–D, adult females (pygidium). A, *Aspidiotus cryptomeriae* Kuw.; B, *Aspidiotus destructor* Sign.; C, *Aspidiotus beilschmiediae*, n. sp.; D, *Aspidiotus watanabei*, n. sp.

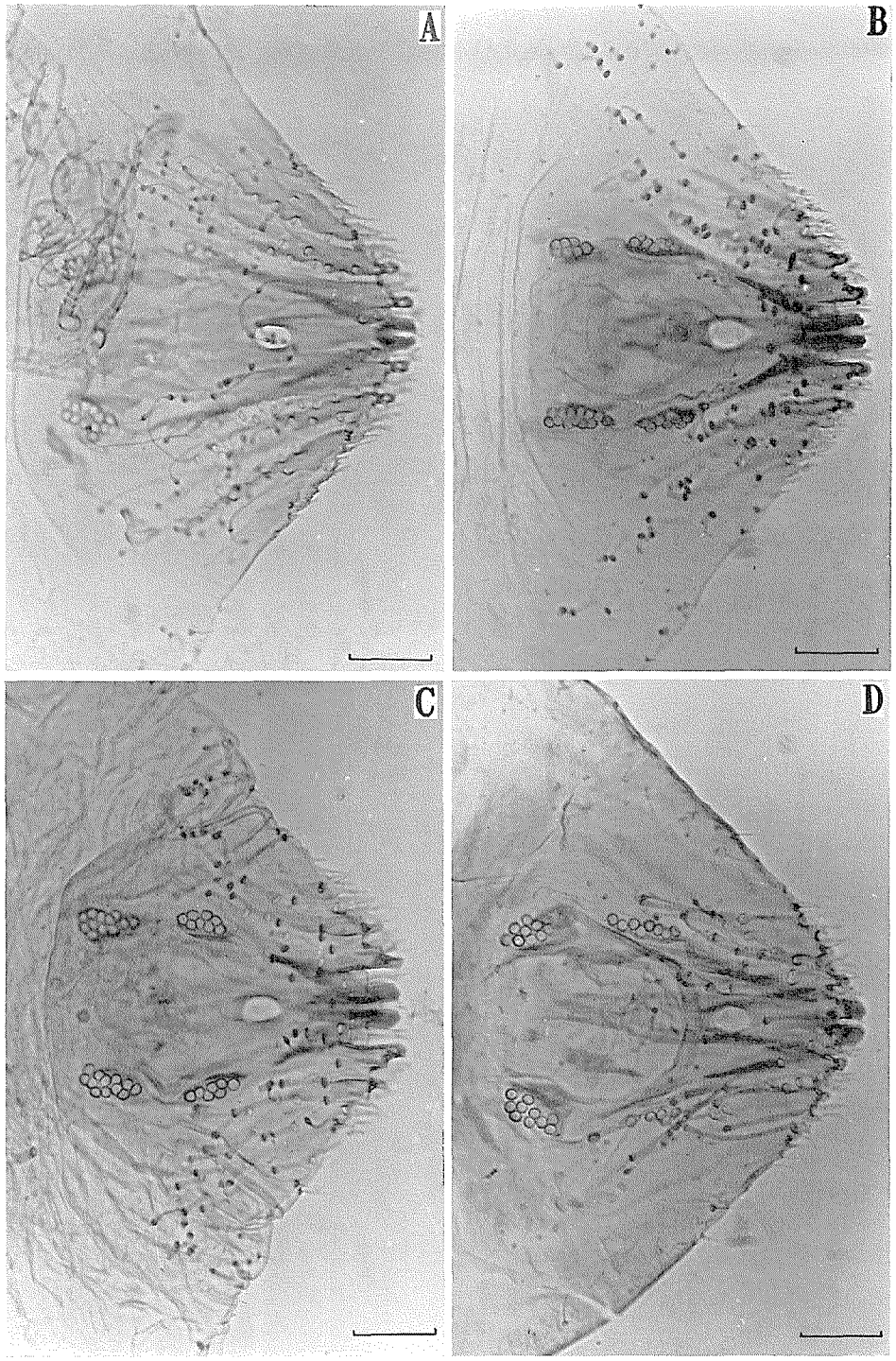

Fig. 30. A–D, adult females (pygidium). A, *Aspidiotus pothos*, n. sp.; B, *Aspidiotus hoyae*, n. sp.; C, *Aspidiotus excisus* Gr.; D, *Taiwanaspidiotus shakunagi* (Takah.).

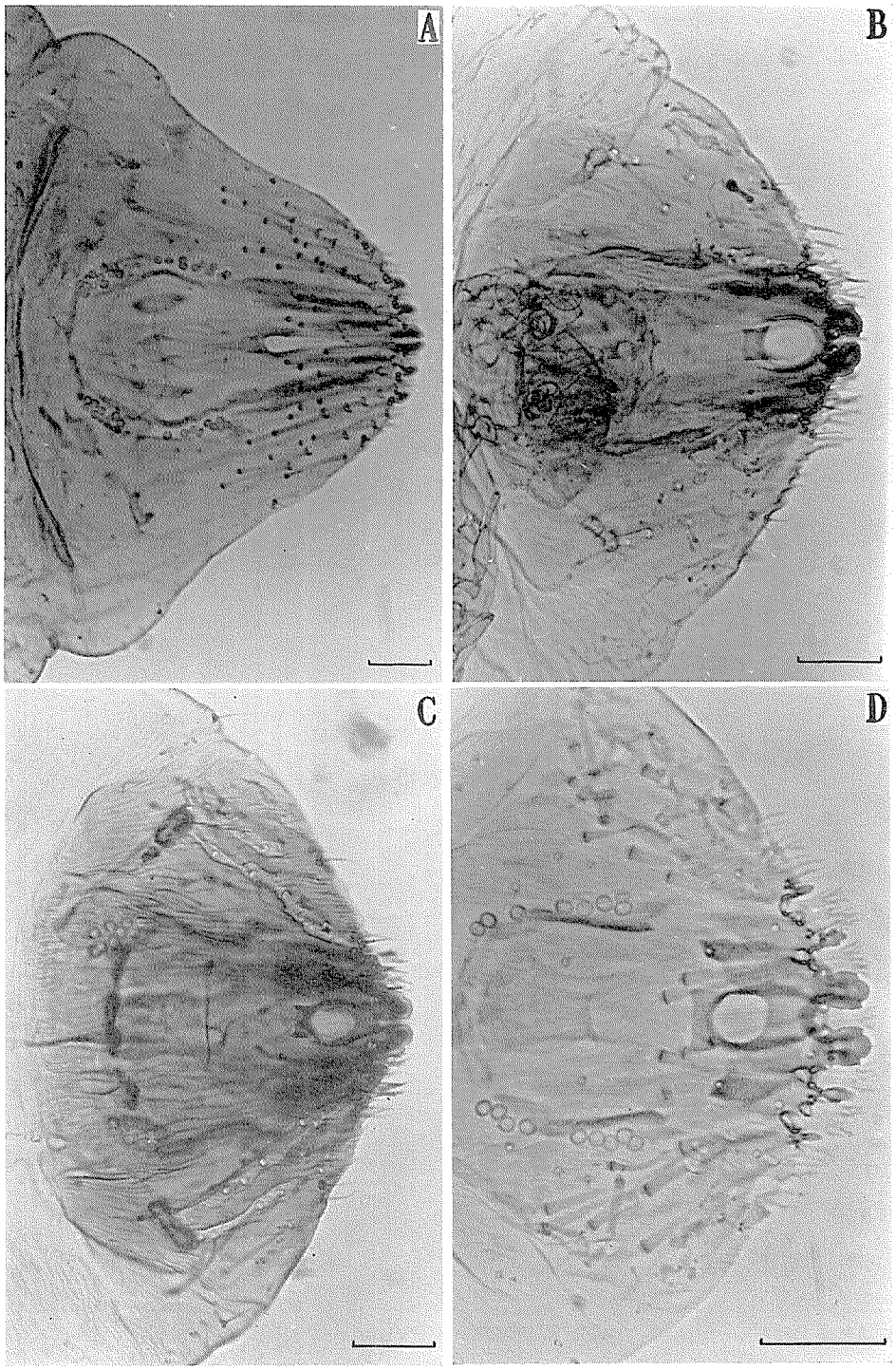

Fig. 31. A–D, adult females (pygidium). A, *Taiwanaspidiotus yiei*, n. sp.; B, *Hemiberlesia rapax* (Comst).; C, *Hemiberlesia lataniae* (Sign.); D, *Hemiberlesia cyanophylli* (Sign.).

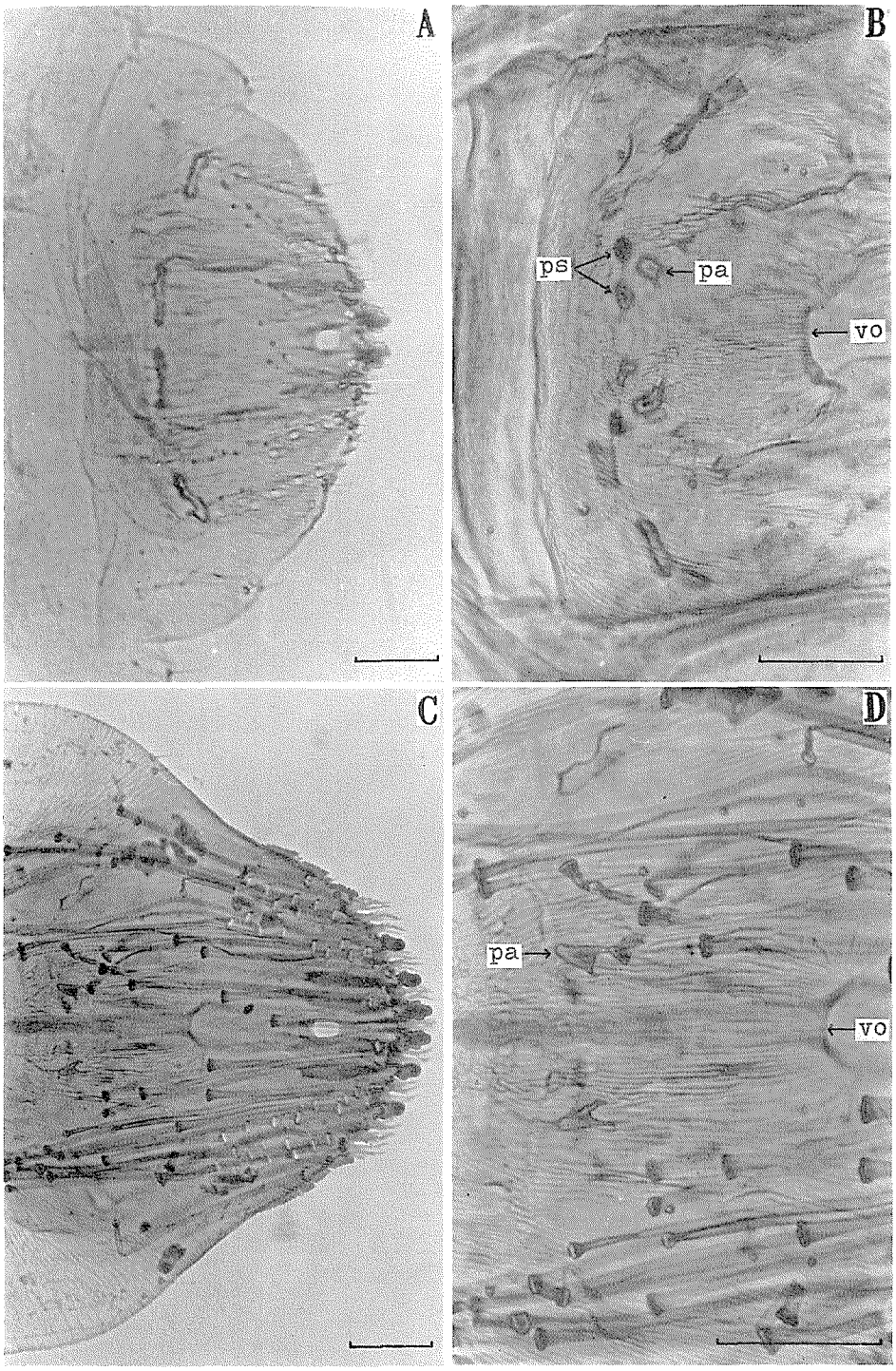

Fig. 32. A–D, adult female (A & C, pygidium; B & D, part of the pygidium).A, *Hemiberlesia pitysophila*, n. sp.; B, *Aonidiella aurantii* (Mask.) (vo, vulvar opening; pa, prevulvar apophysis; ps, prevulvar scleroses); C & D, *Aonidiella citrina* (Coquil.) (vo, vulvar opening; pa, prevulvar apophysis).

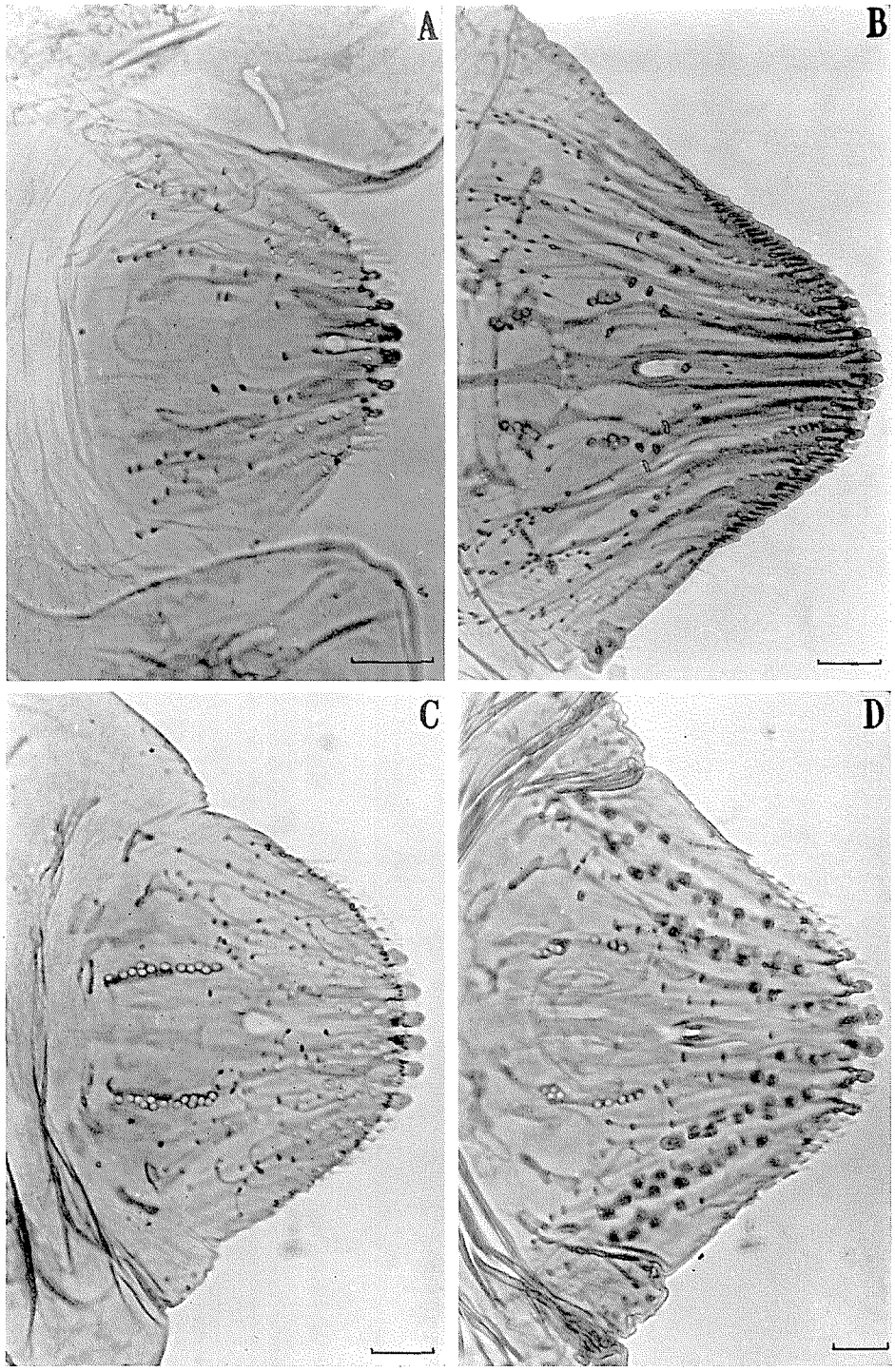

Fig. 33. A–D, adult females (pygidium). A, *Aonidiella inornata* McK.; B, *Lindingaspis ferrisi* McK.; C, *Crassaspidiotus takahashii*, n. sp.; D, *Metaspidiotus stauntoniae* (Takah.).

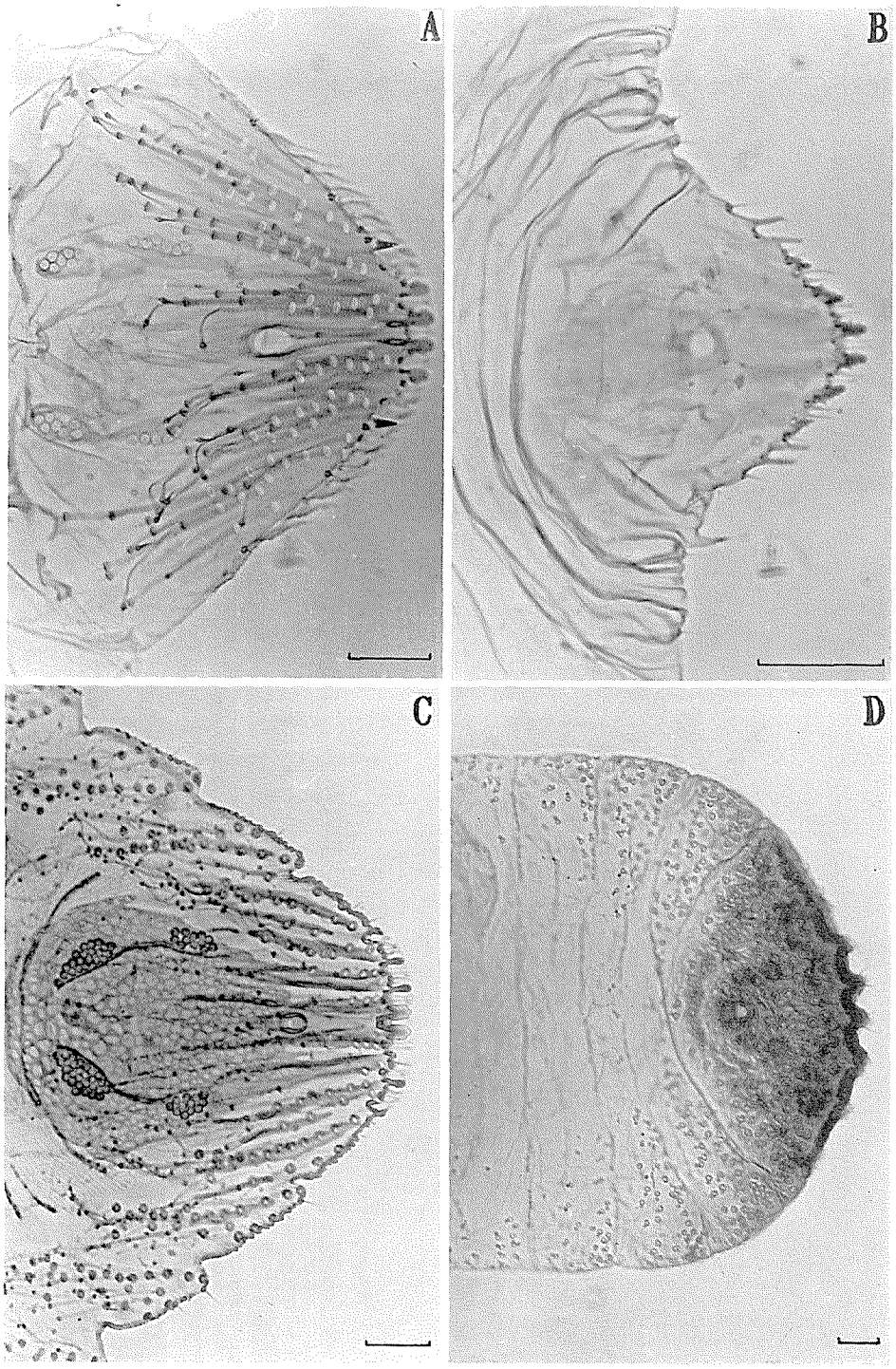

Fig. 34. A–D, adult females (pygidium). A, *Selenomphalus euryae* (Takah.); B, *Diaonidia cinnamomi* (Takah.); C, *Pseudaonidia trilobitiformis* (Gr.).; G, *Pygalataspis miscanthi* Ferr.

Marginal scleroses rudimentary. Dorsal macroducts quite numerous (about 100 in number) on the whole lateral lobe of the first abdominal segment, progressively decreasing in number in the posterior segments. Anterior spiracle with a cluster of nine to 20 disc pores. Perivulvar pores in four groups, 16 to 32 in the anterolateral group, and six to 21 in the posterolateral.

Specimens examined. Yang-ming Shan, on orange tree; northeastern I-lan Hsien, on *Eurya japonica*; Chu-chi, on *Eurya japonica*; Ken-ting, on *Cudrania cochinchinensis* and *Trachelospermum foetidum*; O-luan-pi, on *Ficus swinhoei*.

Distribution and host plants. This species occurs widely in the tropics and subtropics on various kinds of plants. In Taiwan it was recorded by Takahashi from the following plants: *Artocarpus heterophyllus, Calophyllum inophyllum, Citrus* sp., *Diospyros eriantha, Ficus elastica, F. pumila, F. retusa, F.* sp., *Hydrangea* sp., *Machilus* spp., *Murraya exotica, Quercus* sp., *Scolopia oldhamii* and *Camellia japonica*.

Genera incertae sedis

XXII. Genus ***Thysanaspis*** Ferris

References. Ferris *1955 c*: 30; Takagi *1961 a*: 94.

Type-species. *Thysanaspis acalyptus* Ferris.

Diagnosis. Pupillarial, the adult female entirely enclosed within the heavily sclerotized, plump exuvium of the second instar. Body elongate and fusiform, with the derm membraneous throughout, and with the segmentation quite indistinct. Pygidium lacking any distinct marginal processes, with long setae around the margin. Dorsal ducts absent except for some small, slender ducts around the margin of the pygidium. Antenna with four setae. Anterior spiracle with a few disc pores, and with a loose cluster of small ducts just laterally, these ducts with the orifice comparatively large and rounded; posterior spiracle without disc pores. Anal opening situated about the centre of the pygidium. Perivulvar pores forming a shallow arch in front of the vulvar opening; supplementary disc pores forming a submarginal group on each of the preceding two segments.

Second instar female elongate. Pygidium produced, rounded, and margined with a series of remarkable flat processes or plates, which are, except the anteriormost ones, fimbriate apically, and as many as 12 in number on each side. Enormously enlarged ducts of a peculiar shape (resembling the 8-shaped duct) present on the pygidium, each opened through a quite robust, conical, apically truncate process on the margin. Gland tubercles present anteriorly as far as the thoracic region. Exuvium opened by a ventral valve of the pygidium, this valve occupying most of the ventral side of the pygidium.

Composition and distribution. The type-species was described from China. Another species (*litseae* Takagi) occurs in Ryukyu and Japan (Kyusyu). A third species (*perkinsi*, n. sp.) has been found in the present collection.

Remarks. It seems that the type-species is not fully described by Ferris, since his description gives no account of certain characters which are found in the other two species (*litseae* and *perkinsi*) and probably of generic importance. The generic diagnosis given above is based on *litseae* and *perkinsi*. So far as represented by these two species, which are undoubtedly congeneric with the type-species, *Thysanaspis* is closely related with the leucaspidines as already suggested by Balachowsky (*1958 b*: 335). Some

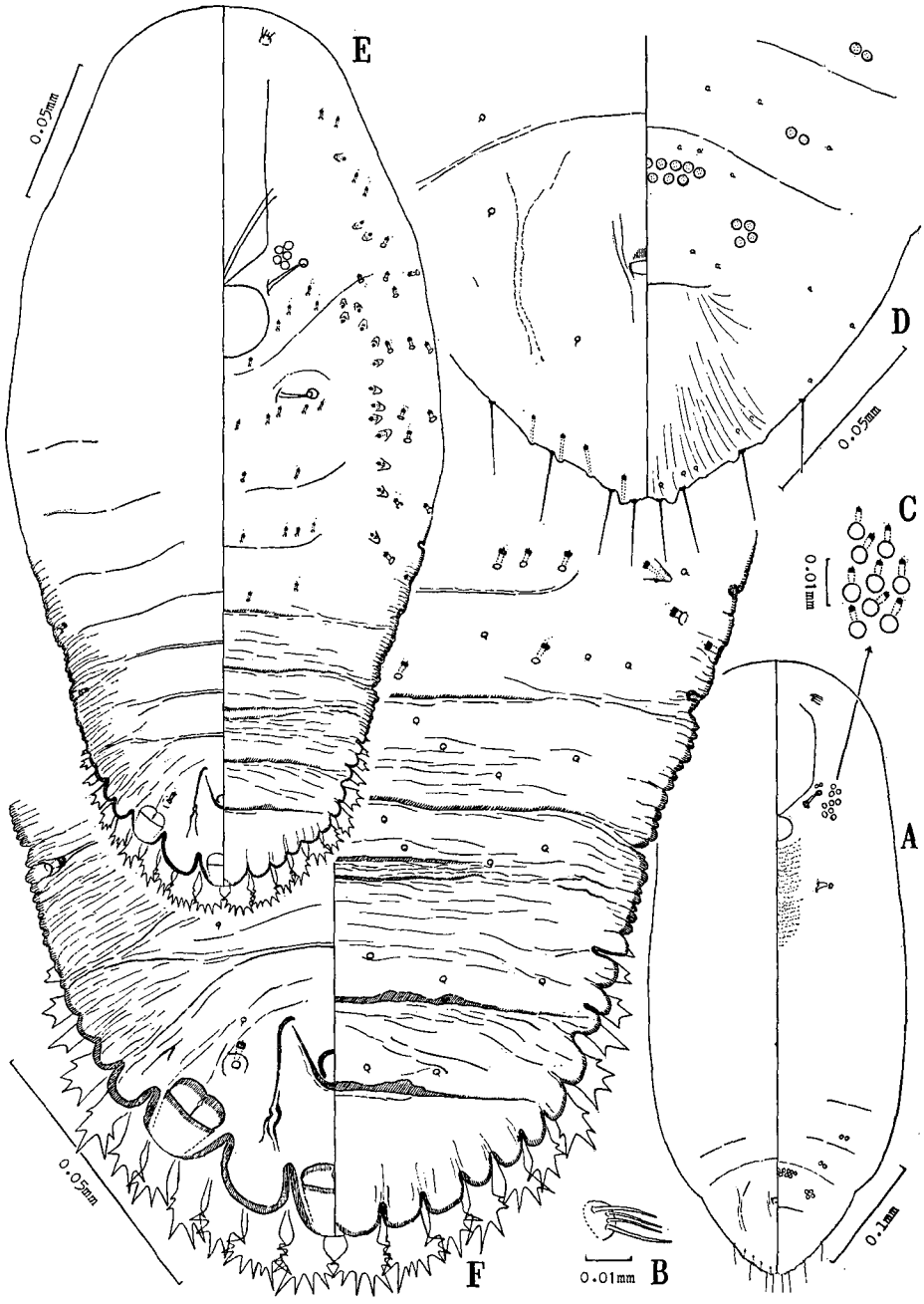

Fig. 35. *Thysanaspis perkinsi*, n. sp. A–D, adult female (A, body; B, antenna; C, duct cluster opposite the anterior spiracle; D, pygidium); E & F, second instar female (E, body; F, pygidium).

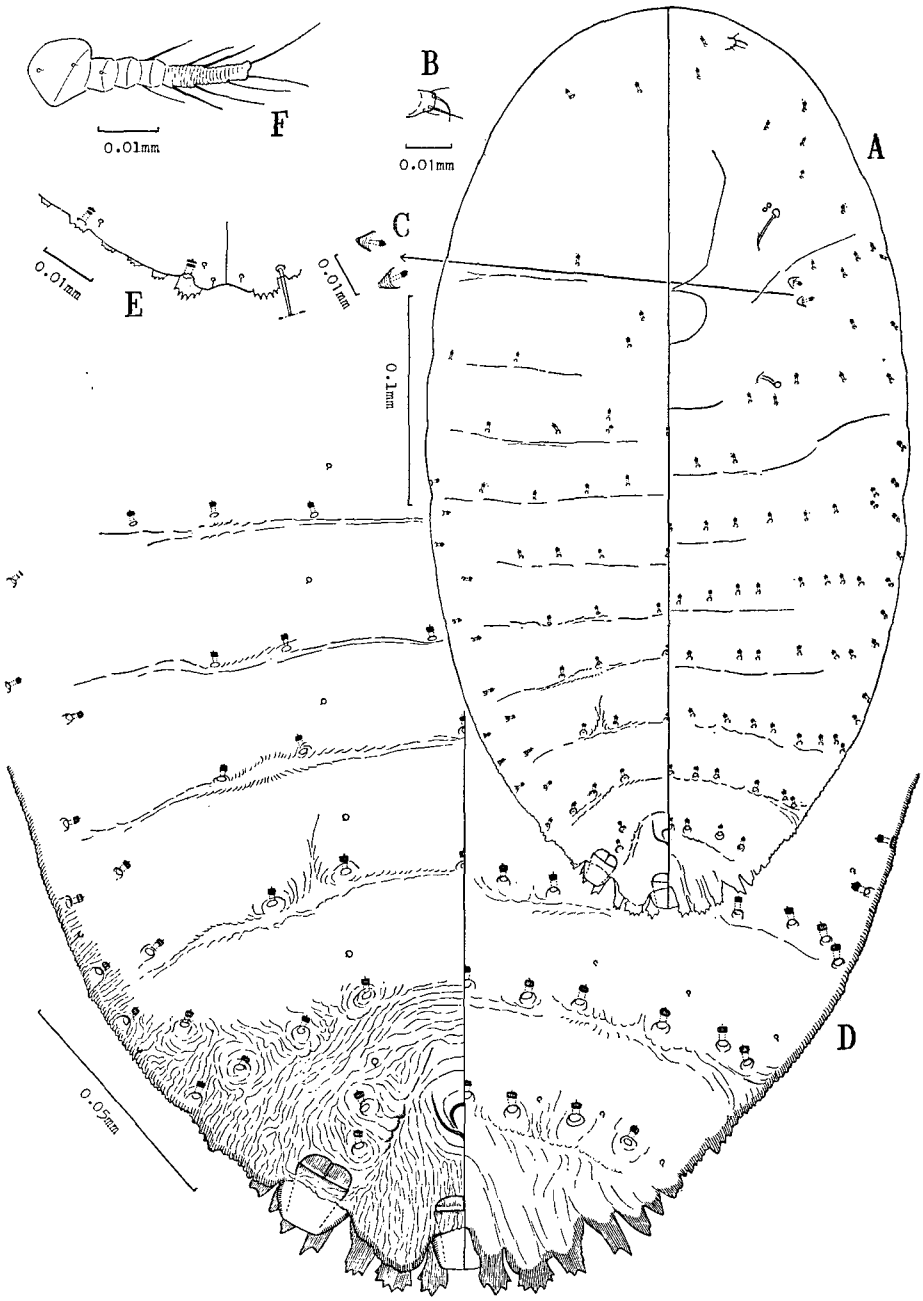

Fig. 36. *Thysanaspis perkinsi*, n. sp. A–D, second instar male (A, body; B, antenna; C, gland tubercles; D, pygidium); E & F, exuvium of the first instar larva (E, posterior extremity of the body; F, antenna).

characters possessed in common by *Tysanaspis* and the leucaspidines are: the non-glanduliferous plates and the presence of gland tubercles in the second instar; the multisetose antennae, the presence of duct clusters laterally to the anterior spiracles, and the arrangement of the abdominal disc pores in the adult female; and the well-developed plates and the presence of marginal macroducts in the first instar. The agreement in all these characters may have some significance, but the absence of pygidial lobes in the larval instars and the adult female and the presence of enlarged peculiar marginal ducts in the second instar in *Thysanaspis* may keep the genus remote from the authentic leucaspidine genera. Although a trial may be taken to place *Thysanaspis* near the Leucaspidini, there is enough ground for controversy in regard to the taxonomic position of the genus.

48. ***Thysanaspis perkinsi***, n. sp. [Fig. 35; 36]

Diagnosis. Pygidium triangular in outline, with four pairs of long setae and six to eight slender ducts all around the apical margin, the marginal ducts being somewhat irregular in arrangement. Antenna with four setae, of which two are less thickened than the other two. Anterior spiracle with one to three disc pores, and with a cluster of eight to 17 ducts just laterally. Eight to 19 perivulvar pores in a transverse median group, and four to six in each lateral group, all these groups forming a shallow arch in front of the vulvar opening; one or two disc pores on the ultimate and often also on the penultimate prepygidial segment in the submarginal region.

Second instar female with three (one median and two lateral) enlarged marginal ducts on the pygidium. Anterior spiracle with four or five disc pores.

Specimens examined. Kuan-tzu-ling, on the leaves of *Litsea akoensis*.

Remarks. This species is very close to *litseae*, from which it is distinguished mainly by the number of the enlarged marginal ducts on the pygidium of the second instar female: in *perkinsi* these ducts are present, in addition to the median one, only in one lateral pair, whereas in *litseae* in two lateral pairs. I have failed to find any distinct difference between the adult females of the two perhaps owing to extreme retrogression in this instar.

XXIII. Genus ***Pygalataspis*** Ferris

References. Ferris *1921 a*: 218.

Type-species. *Pygalataspis miscanthi* Ferris.

Diagnosis. Body stout, elongate, with the free segments little lobed out laterally. Derm sclerotized on the pygidium and on the lateral area of some posterior free abdominal segments. Pygidium rounded, the marginal area more or less folded and heavily sclerotized, with numerous macroducts crushed among the folds. Flattened and often toothed marginal processes or plates prominent in four pairs around the pygidium, arising in part from broad rounded prominences of the pygidial margin, which are present in two distinct pairs. Elongate marginal setae around the apex of the pygidium. Macroducts rather small, practically same in size and shape on both surfaces, numerous and strewn on the pygidium and as far as the thoracic region along the margin, those on the pygidium and posterior prepygidial segments with the orifice surrounded by a quite thickly sclerotized rim. Antennae with short setae. Both pairs of spiracles with disc pores. Anal opening close to the base of the pygidium. Perivulvar pores

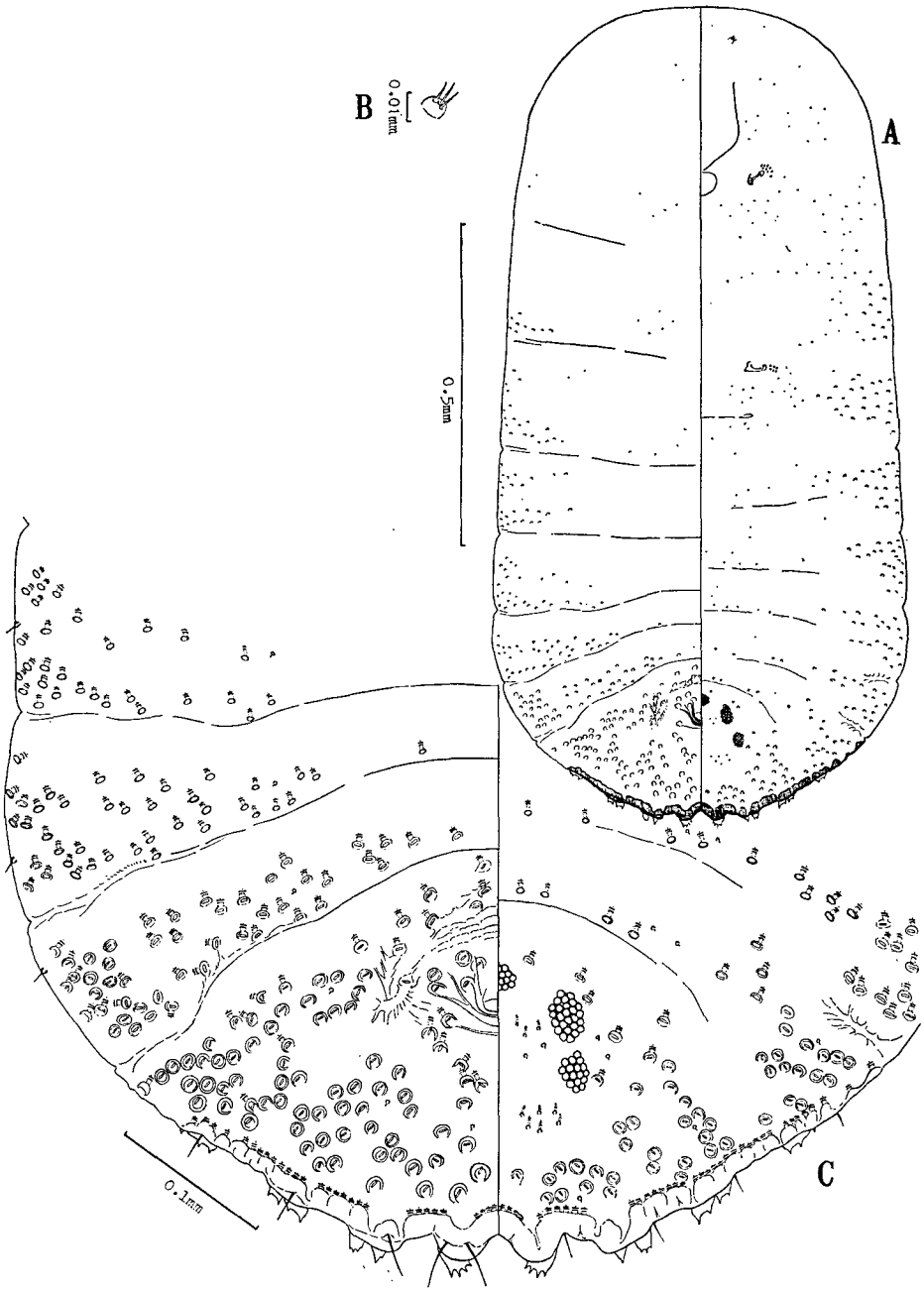

Fig. 37. *Pygalataspis miscanthi* Ferr. Adult female (A, body; B, antenna; C, pygidium).

in five groups.

Composition and distribution. This genus is represented only by the type-species occurring in eastern Asia (Taiwan and Hongkong).

Remarks. This genus is so unique and peculiar that it is not easy to locate it near any other known genus. Some larval characters of the type-species, based on specimens from Hongkong, should be given below.

In the first instar the antennae are five-segmented, with the terminal segment not annulated, and the head is devoid of enlarged dorsal ducts. At the posterior end of the body a pair of sclerotized processes situated laterally to the apical setae may be called lobes, whereas another pair of slender sclerotized processes are found between these setae; otherwise, the marginal processes of the body are little developed. The marginal ducts are not reduced in size and show an 8-shaped figure in cross section.

In the second instar the marginal structure of the pygidium is, in both sexes, basically identical with that of the adult female. In the second instar female all the ducts on both surfaces show an 8-shaped figure in cross section.

The most important of the larval characters is the presence of the 8-shaped duct in the first instar and the second instar female. Because the 8-shaped duct is looked upon as a transitional type between the duct of the Diaspididae and the geminate pore of the Asterolecaniidae, its presence in *Pygalataspis* may give evidence of an old origin of the genus.

In certain characters of the adult female *Pygalataspis* is similar to the rugaspidiotines, and it is possible that the genus may have some relation with the Rugaspidiotini. By the way, the tribe Rugaspidiotini may be also of an old origin, the 8-shaped duct being found in the first instar larva and the second instar female of a certain species (*Smilacicola apicalis*) of the tribe.

49. ***Pygalataspis miscanthi*** Ferris [Fig. 34 D; 37]

References. Ferris *1921 a*: 218; ibid. *1937 a*: 41 [illustration].

Diagnosis. Body attaining about 2.5 times as long as wide, little or slightly broader posteriorly in the prepygidial region, with the pygidium broad. Plates single in the mesalmost pair (on the eighth abdominal segment), double on the seventh segment, double or triple on the sixth segment, and single and tending to be reduced in the outermost pair (on the fifth segment). Pygidium with macroducts strewn over the whole dorsal surface, but largely confined to a broad marginal zone on the ventral surface; preceding segment (fourth abdominal segment) with macroducts strewn across. Both pairs of spiracles with small ducts (microducts) scattered posteriorly. Antenna with three or four short setae. Anterior spiracle with a loose cluster of six to 10 disc pores; posterior spiracle with two to seven. Fifteen to 20 perivulvar pores in the median group, 14 to 26 in the anterolateral, and nine to 19 in the posterolateral.

Specimens examined. Kuan-tzu-ling, on *Miscanthus* sp.

Distribution and host plants. This species was described from Taiwan as a feeder of *Miscanthus sinensis*, and later recorded from Kowloon Peninsula, Hongkong.

ERRATA

Vol. 32, Part 1, p. 5, line 17 from bottom, for "scond" read "second"; p. 6, line 4 from bottom, for "intar" read "instar"; p. 14, line 6 from bottom, for "ramarkable" read "remarkable"; p. 31, bottom, for "*1968*" read "*1868*"; p. 108, line 1, for "*Tysanaspis*" read "*Thysanaspis*".

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